



# Project Manual

for

## NORTH PARIS FIRE STATION

21 Ann Wilson Way  
Paris, Ontario

Issued for Tender  
2025-07-09

Prepared by



609 Kumpf Drive, Suite 101  
Waterloo, ON  
N2V 1K8

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26 36 23	AUTOMATIC TRANSFER SWITCHES	E	0	2025-07-08
26 43 13	SURGE PROTECTIVE DEVICES	E	0	2025-07-08
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END OF SECTION

The following participants comprise the licensed professionals providing design Drawings and/or Specifications for the project:

**Architect and Prime Consultant**

Masri O Inc. Architects  
609 Kumpf Drive, Suite 101  
Waterloo, Ontario  
N2V 1K8  
T: (519) 579-0072  
www.masrioarchitects.ca  
Contact: Reema Masri

**Mechanical and Electrical Engineer**

DEI Consulting Engineers  
55 Northland Road  
Waterloo, Ontario  
N2V 1Y8  
T: (519) 725-3555  
Contact Mechanical: Jesse Anderson  
Contact Electrical: Jason Legacy

**Structural and Civil Engineer**

MTE Consultants Inc.  
520 Bingemans Centre Drive  
Kitchener, Ontario  
N2B 3X9  
T: (519) 743-6500  
Contact Civil: Christine Metrie  
Contact Structural: Paul Slater

**Landscape Architect**

Hill Design Studio Inc.  
#303 – 1601 River Road East  
Kitchener, Ontario  
N2A 3Y4  
T: (226) 686-0700  
Contact: Aaron Hill



**THE CORPORATION OF THE COUNTY OF BRANT**

**REQUEST FOR TENDER**

**TENDER NO. CPS-RFT-25-03**

**North Paris Fire Station**

**CLOSING DATE and TIME:**

**August 6, 2025, 2:00:59 pm (local time)**

## TENDER INFORMATION SUMMARY

Date Released	July 9 <sup>th</sup> , 2025
Site Visiting	Visit site at own discretion.
Question Deadline	July 30 <sup>th</sup> , 2025 by 4:30:59 pm (local time)
Bid Closing Date & Time	August 6 <sup>st</sup> , 2025, 2:00:59 pm (local time)
Tentative Contract Award Date	September 3 <sup>rd</sup> , 2025
Bid Bond required	5% of contract value Required
Consent of Surety	Required
Performance Bond as per Section 00 60 00	50 % of Bid Amount
Labour and Materials Payment Bond as per Section 00 60 00	50 % of Bid Amount
Maintenance/Warranty Period	As per CCDC 2-2020.
Payments	as per Section 01 29 00 - Payment Procedures
Holdbacks	as per Section 01 29 00 - Payment Procedures
Commencement Date	September 10 <sup>th</sup> , 2025
Completion Date	March 10 <sup>th</sup> , 2027
Number of Days Tender Open	60 days
Insurance Amounts	Per CCDC 41
Parties to be Named on Insurance	Corporation of the County of Brant & Consultants
Alternate Prices List per Appendix C	Required from Low Bidders 48 hours after closing
Indication of Number of Addenda	Required
Tender Signed and Sealed	Required
Appendix A - Bid Form Completed	Required
Appendix B - Information Submittal Forms completed	Required
Appendix C – Additional Information Submittal Forms completed	Required from Low Bidders 48 hours after closing

**County of Brant  
Operations Department - Public Works**

**Tender No. CPS-RFT-25-03  
North Paris Fire Station**

**Notification of Tender Call**

**ELECTRONIC BID/QUOTE SUBMISSIONS** for “**CPS-RFT-25-03 North Paris Fire Station**” will be received by the County of Brant via the Bidding System at [bids.brant.ca](https://bids.brant.ca) until:

**2:00:59 PM Local Time,  
August 6<sup>th</sup>, 2025**

For the construction of a new Fire Station on a vacant parcel of land municipally known as 21 Ann Wilson Way, Paris and in accordance with Tender Documents issued by Masri O Architects, dated July 9th, 2025.

Tender documents including plans/specifications (if any) may be obtained from the County of Brant Website at [bids.brant.ca](https://bids.brant.ca) commencing on July 9th, 2025. All bidders must register to obtain documents.

CPS-RFT-25-03 will not be opened publicly.

Each Tender shall be accompanied by a scan of a Bid Bond in the amount of 5% of the Bid payable to the “Corporation of the County of Brant” as a security deposit.

The Tender shall be subject to the requirements of the County of Brant’s Purchasing Policy By-Law No. 87-22. Tenders that are deemed to be incomplete, altered, or not in compliance with the requirements will not be evaluated.

All items are conditional subject to funding approval by County of Brant Council.

**Note:** Email, hard copy and facsimile submissions will not be accepted.  
All bids must be submitted via the Bidding System at [bids.brant.ca](https://bids.brant.ca).

**Any questions respecting this Request for Tender should be submitted through  
the Question Portal on [bids.brant.ca](https://bids.brant.ca)**

By submitting a bid in response to this Request to Tender, the bidder hereby declares that:

- I/we acknowledge that the Bid Documents, including any and all addenda issued by the County, are part of this Contract;
- I/we agree to supply the requirements and services and to perform the work required by the Contract within the required completion time specified in the Bid Documents;
- No member of the County Council, or any officer or employee of the County is, or will become interested directly or indirectly as a contracting party, partner, stock holder, surety or otherwise in, or in the performance of, the Contract, or in the supply, work or business to which it relates, or in any portion of the profits thereof, or any money to be derived therefrom;
- This Tender is made without a connection, comparison of figures or arrangement with any other Bidder, and is in all respects fair and without collusion or fraud;
- Bidders must disclose to the County, in their Tenders, any potential or existing conflict of interest that might compromise the performance of the work under the Contract or the acceptance of the Tender. If such a conflict of interest does exist, the County may, in its sole discretion, refuse to consider the Tender.
- If I/we withdraw this Tender after Bid Closing Date and prior to award of the Contract, during the time that this Tender is open for acceptance as set out in this Request for Tender, the full amount of the Bid Deposit accompanying this Tender shall be forfeited to the County;
- I/we acknowledge that the information contained in this Tender shall be subject to disclosure as may be required under the provisions of the Municipal Freedom Information and Protection Act (MFIPPA), and that any confidentiality obligations of the County under the Request for Tenders are expressly subject to the obligations and requirements of MFIPPA now or hereafter in effect; and
- A Bid Bond is enclosed in the same envelope or package as the Tender.
- In addition to any other rights reserved to the County, the County reserves the right, privilege, entitlement and absolute discretion for any reason whatsoever to
  - accept a tender which is not the lowest Bid;
  - reject a Tender which is the lowest Bid, even if it is the only Tender received;
  - cancel the Request for Tender at any time, either before or after the Bid Closing;
  - accept or reject any and all Tenders, whether in whole or in part;
  - except in the case of a Material Irregularity, accept an Irregular Tender;
  - award any part of a Tender or to award the Contract on a lot, unit or item basis; and
  - accept or reject an unbalanced Tender.

Authorized Signature

Date

Company Seal



# INFORMATION TO BIDDERS

## 1. INTERPRETATION / DEFINITIONS

The following words will have the definitions assigned to them below. These definitions will supplement the definitions in the Contract Documents.

“Accredited Surety” means the surety company licensed by the Financial Services Regulatory Authority of Ontario to issue bonds in the Province of Ontario.

“Addenda” or “Addendum” means a document containing additional information, clarifications, or changes to the requirements of the Bid Document issued by the Corporation of the County of Brant which is part of the Bid Document.

“Agreement” means the Agreement provided by CCDC 2 Stipulated Price Contract, 2020 edition.

“Bid”, “Offer” or “Tender” means act of submitting an offer under seal.

“Bid Bond” means the security deposit issued by an Accredited Surety in the amount of ten percent (5%) of the Bid Price. The Bid Bond must be payable to the Corporation of the County of Brant as obligee, signed and sealed by the principal (Bidder) and Accredited Surety. Use latest edition CCDC-approved bond forms.

“Bid Closing” means the date which Bid Closing takes place.

“Bid Closing Time” means the completion of the request for Tender after which Bids will no longer be accepted.

“Bid Deposit” means the “Bid Bond”.

“Bid Document” or “Bid Documents” means “Contract Documents” supplemented by this Request for Tender document, - Bid Form, Appendix A - Information Submittal Forms, Appendices B and C - Bonding, Section 00 70 00\_00 - General Conditions, and Section 00 80 00 - Supplementary Conditions, issued by the County to Bidders, and shall include any and all Addenda.

“Bidder” means any proponent, respondent or other person or entity who has obtained Bid Documents from the County for the purpose of submitting, or who has submitted, a tender in response to this Request for Tenders.

“Bid Form” means Bid Form included in Call for Tender as Appendix A.

“Bid Form Supplements” means the documents included in the Call for Tender as Appendices B and C as Information Submittal Forms.

“Bid Price” means the monetary sum identified in Section 00 40 50 - Bid Form.

“Consent of Surety” means an Accredited Surety’s written assurance that they will provide the bonds stipulated by Section 00 60 00 – Bonding in the event of Contract being awarded to Bidder.

“Construction Act” means the Construction Act (Ontario) R.S.O. 1990, c. C. 30

“Contract” means the contract as defined by CCDC 2 Stipulated Price Contract (2020 edition) and Section 00 80 00 - Supplementary Conditions, and Special Provisions as included in this Request for Tender document, which governs the Work set out in the Bid Documents, and has been executed by the County and the Successful Bidder following acceptance by the County of the Successful Bidder’s Bid.

“Contract Documents” means the documents as identified in CCDC 2 Stipulated Price Contract (2020 edition), Agreement, Definitions, General Conditions, Supplementary Conditions, the “SPECIAL PROVISIONS” of this Request for Tender, and the Design Drawings and Specifications.

“Contract Administrator” means the name of the County staff member, consultant or such other delegates as may be authorized by the County to act in any particular capacity.

“Contractor” means the legal entity undertaking the execution of the Work under the terms of the Contract.

“County” means The Corporation of the County of Brant.

“County Project Manager” means the County’s Project Manager or such other delegates as may be authorized by the County to act in any particular capacity.

“Irregularity” means a variation in a Tender from the requirements of the Request for Tender.

“Material Irregularity” means an Irregularity that is substantial and material to an award, which could give a Bidder an unfair advantage over others who have submitted a Tender.

“Project” means the Project described in Section 01 11 00 - Summary of Work.

“Project Lead” means and County staff person or consultant, on behalf of the County who is the lead representative.

“Proper Invoice” means “Proper Invoice” as defined by Section 00 80 00 - Supplementary Conditions.

“Successful Bidder” means the Bidder to whom the Contract is awarded.

The definitions specified in CCDC 2-2020 and the Ontario Building Code apply to this project and all Bid Documents issued.

“Section”, when used in the Specifications, means specification Section as defined in accordance with CSI/CSC MasterFormat®, PageFormat® and SectionFormat®.

All defined terms shall have the meanings assigned to them in the Contract Documents.

## 2. INVITATION

- .1 The intent of this Request for Tender is to obtain offers to perform all works and services required to complete the entire scope of work referred to as CPS-RFT-25-03 North Paris Fire Station for the County, in accordance with the Agreement, Definitions and General Conditions of executed CCDC 2 Stipulated Price Contract (2020 edition) as amended by supplementary general conditions per Section 00 80 00 - Supplementary Conditions and the **SPECIAL PROVISIONS** of this Request for Tender. The successful Contractor will be required to sign Contract at time of award.
- .2 Project description: refer to Section 01 11 00 - Summary of Work.

## 3. OBTAINING DOCUMENTS

- .1 All Bidders must have a Bidding System Vendor account and be registered as a “Plan Taker” for this Bid opportunity, which will enable the Bidder to download the Bid Call Documents, to receive Addenda email notifications and download all documents without the watermark “preview” on them. To ensure receipt of the latest information and updates via email regarding this bid, or if a Bidder has obtained this Bid Document from a third party, the onus is on the Bidder to create a Bidding System Vendor account and be register as a Plan Taker for the bid opportunity.
- .2 Bid documents may be viewed free of charge on the County’s bid posting website [www.bids.brant.ca](http://www.bids.brant.ca)
- .2 Bidders shall verify that the Bid Documents are complete. Bidders shall immediately notify the County if the Bid Documents are incomplete or upon finding discrepancies, errors, or omissions in the Bid Documents.
- .3 Bid Documents are made available only for the purposes of obtaining bids for the Project. Their use does not confer a license or a grant for other purposes.
- .4 Bidders must register as a plan taker to be able to submit a bid.
- .5 The Bidder acknowledges that it is solely responsible for obtaining and reviewing all Bid Documents and all addenda issued by the County pertaining to the Project.

## 4. SUBMISSION OF TENDERS

- .1 All bids must be submitted electronically no later than the Closing Date and Time via the Bidding System at [bids.brant.ca](http://bids.brant.ca).
- .2 All Bidders shall have a Bidding System Vendor account and be registered as a Plan Taker for this Bid opportunity, which will enable the Bidder to download the Bid Call Document, to receive Addenda email notifications and download all documents without the watermark “preview” on them.

- .3 It is each Bidder's sole responsibility to ensure that their Bid is received by the Bid Closing Time on the Bid Closing Date. Bidders are cautioned that the timing of their Bid Submission is based on when the Bid is RECEIVED by the County via the Bidding System at bids.brant.ca, not when a Bid is submitted, as Bid transmission can be delayed due to file transfer size, transmission speed, etc.
- .4 For the above reasons, it is recommended that sufficient time is allotted to complete your Bid Submission and to resolve any issues that may arise.
- .5 Late Bids are not permitted/accepted-
- .6 To ensure receipt of the latest information and updates via email regarding this bid, or If a Bidder has obtained this Bid Document from a third party, the onus is on the Bidder to create a Bidding System Vendor account and register as a Plan Taker for the bid opportunity.
- .7 **Bidders shall submit through the electronic bidding system, as instructed, the following documentation with their Bid, each properly filled out in full and signed and initialed as required, prior to Bid Closing Time.**
- Completed **Appendix 'A' – (Bid Form)**, available electronically via the Bidding System at bids.brant.ca;
  - **Bid Bond** in the minimum amount of 5% of the Bid Price, made out in favour of the Corporation of the County of Brant;
  - **Consent of Surety** issued by a company licensed to carry on such business in Province of Ontario for the provision of a Performance Bond and Labour and Materials Payment Bond in the amounts listed in Section 00 60 00 - Bonding;
  - Current proof of **undertaking of insurance** as per CCDC 2 2020 requirements.
  - Completed **Appendix 'B' – (Bidder Information and Bidder Declaration form, Supervisory Experience form, Subcontractor List form, and Wage Rates form)**, available electronically via the Bidding System at bids.brant.ca, submitted according with the instruction on the Bidding System;
  - Completed **Appendix 'C' – (Tender Price Breakdown and Alternative Pricing)**. To be submitted by the lowest bidder(s) within 48 hours of the closing date and time. This shall be submitted to [brantpurchasing@brant.ca](mailto:brantpurchasing@brant.ca).
- .8 The Bid Price shall include all labour, expertise, construction tools, equipment, materials, utilities and transportation services, supervision, office support, overhead and profit, and customs and duties, necessary to, and the cost of all licenses, approvals and other permits and inspections required by any government or other authority to, perform and complete all work required under the Contract, including all miscellaneous work, whether specifically included in the Bid Documents or not. Any items omitted which are necessary for the completion of the Contract work shall be considered to be part of the work, even though not directly specified in the Bid Documents, and shall be considered by the Bidder in preparation of the Tender.

- .9 All prices shall be quoted in Canadian Dollars and exclusive of HST (HST extra).
- .10 Tenders based upon an unreasonable period of time for the completion of work required to complete the Contract may, at the County's sole discretion, be rejected.
- .11 Bidders must disclose to the County, in their Tenders, any potential or existing conflict of interest that might compromise the performance of the work under the Contract or the acceptance of the Tender. If such a conflict of interest does exist, the County may, in its sole discretion, refuse to consider the Tender.
- .12 All Tenders submitted to the County become the property of the County. All information in a Tender will be subject to the provisions of the *Municipal Freedom of Information and Privacy Act* and the Bid Document.
- .13 A Bidder may withdraw their Tender at any time prior to the Bid Closing Date and Time. However, the Bidder is solely responsible to ensure the re-submitted bid is received by the County no later than the stated closing time and date.
- .14 Hard copy Tenders and amendments to Tenders as well as those submitted by telephone or facsimile will not be accepted by the County.
- .15 Bidders agree to prepare and submit Tenders at their own cost. The County is not obligated in any way to pay costs or any kind or nature whatsoever that may be incurred by a Bidder or any third parties in relation to this Request for Tenders. All such costs shall be the bidder's sole responsibility. By submitting a Tender in response to this Request for Tender, a Bidder expressly waives any and all claims for damages, costs, liability and expenses of any kind or nature which related to the preparation or submission of the said Tender.
- .16 The Tender procedure shall be governed by the County of Brant's Purchasing Policy By-Law No. 45-13, a copy of which can be obtained from the County of Brant, Burford Office or from the County of Brant website at [www.brant.ca](http://www.brant.ca).

## 5. QUESTIONS AND ADDENDA

- .1 All questions from Bidders related to the Request for Tenders are to be submitted through the "Submit a Question" portal on the County's bid posting website ([www.bids.brant.ca](http://www.bids.brant.ca)).
- .2 Written requests for questions/clarification must be received by the Question Deadline.
- .3 Any Bidder who requests and/or receives information related to the Request for Tenders through any other means may be disqualified from further consideration.
- .4 The County reserves the right to not accept, consider or respond to any questions received after the specified deadline has passed.
- .5 Responses to question which requires an addition to, deletion from, or alteration of the requirements of the Bid Documents will be provided to all Bidders in writing as addenda.
- .6 Addenda shall be deemed to be part of the Bid Document. Bidders shall consider the requirements of all Addenda in the preparation of their Tender. Bidders shall include the cost implications of all addenda in their tender.

- .7 Should a Bidder find discrepancies, ambiguities or omissions in the Bid Document, or have questions about the meaning or intent of anything in the Bid Documents, prior to Bid Closing, the Bidder shall notify the County through the question portal as soon as possible.
- .8 All Addenda will be posted to the County's bid posting website at [www.bids.brant.ca](http://www.bids.brant.ca).
- .9 Receipt of all addenda must be acknowledged through the bidding portal.
- .10 No Addenda will be issued within forty-eight (48) hours of Bid Closing except to extend Bid closing or to cancel the Request for Tender.
- .11 Bidders shall acknowledge receipt of any addenda through the Bidding System by checking a box for each addenda and any applicable attachment.
- .12 It is the responsibility of the Bidder to have received all Addenda that are issued. Bidders should check online at [bids.brant.ca](http://bids.brant.ca) prior to submitting their Bid and up until Bid closing time and date in the event additional addenda are issued.
- .13 If a Bidder submits their bid prior to the Bid closing time and date and an addenda have been issued, the Bidder shall withdraw their Bid and resubmit acknowledging the addendum through the Bidding System.
- .14 The Bidder is solely responsible to:
  - make any required adjustments to their Bid; and
  - acknowledge the addenda; and
  - Ensure the re-submitted Bid is RECEIVED by the Bidding System no later than the stated bid closing time and date.

## **6. COMMUNICATION**

- .1 Any communication by a bidder with an employee, elected official, officer, agent, consultant, advisor or other representative of the County concerning the Request for Tender may result in the disqualification of the Bidder from participating in this Request for Tender, at the sole discretion of the County.

## **7. OPENING OF TENDERS**

- .1 Tenders will not be opened publicly by the County. Unofficial Tender results will be available on the County bid posting website [www.bids.brant.ca](http://www.bids.brant.ca).
- .2 The County reserves the right not to proceed with the opening of Tenders and to delay or change the Bid Closing Date and Bid Closing Time for any such reason as the County may deem appropriate, in the County's sole discretion.

## **8. EXAMINATION OF THE SITE**

- .1 Bidders shall be responsible for visiting and carefully examining the Project site and for informing themselves fully as to all existing local conditions, limitation, access, surrounding and subsurface site conditions and all other conditions which may be encountered during the performance of the work required to complete the Contract. Bidders will not be entitled to receive any compensation as a result of their failure to visit or to carefully examine the Project site.



- .2 Bidders shall not claim at any time after submission of a Tender that they had any misunderstanding of site conditions or of the terms and conditions of the Contract relating to site conditions.
- .3 Bidders shall immediately notify the County of any site conditions which may adversely affect the completion of the Contract.
- .4 Bidders shall include all costs to complete the Contract in their Bid price. The County will not consider any claims, and no amounts will be paid, for additional time required to complete the Contract or, for extra work, costs, damages, expenses or difficulties encountered as a result of site conditions which were either visible or which could be reasonably inferred from an examination of the Bid Documents and a careful examination of the Project site or adjacent surrounding public or private property prior to Bid Closing.

## **9. SUBCONTRACTORS**

- .1 Bidders shall submit a list of their proposed Subcontractors in the required Bid Form Supplement which shall include the names of all of the Subcontractors which the Bidder proposes to use under the Contract and the portion of the Work that each Subcontractor to be responsible for. See Appendix 'B' – Information Submittal Forms, available electronically via the Bidding System at [bids.brant.ca](http://bids.brant.ca);
- .2 Bidders shall ensure that all Subcontractors listed have experience in the work described, have submitted their prices in accordance with the Bid Document, and that they will execute their work with competence and within the required time frame.
- .3 Bidders shall not indicate "TBD" (To Be Determined) or "TBA" (To Be Announced) or similar wording and shall not indicate multiple choices of Subcontractor names for any Subcontractor category in their list of Subcontractors. One Subcontractor name shall be indicated for each Subcontractor category.
- .4 Bidders shall list all Subcontractors that will perform work under the Contract in their list of Subcontractors.
- .5 No names of Subcontractors may be changed or added after submission of the List of Subcontractors unless prior written approval is received from the County, which may be provided or refused in the County's sole discretion.
- .6 Failure to name any, or to name properly any subcontractors shall constitute an Irregularity permitting the County at its sole discretion to reject the bid.
- .7 The County reserves the right to reject a proposed Subcontractor in its sole discretion. Upon such rejection, the Bidder shall propose an alternate Subcontractor and identify any resulting change to the Bid Price. This change can affect the status of the low Bid, and may result in a different Tender becoming the low Bid.
- .8 By submitting A Bid, the bidder accepts that the County has no liability to the Bidder or any subcontractor or third party related to the rejection of a subcontractor who is unsatisfactory to the County in its sole discretion.

## 10. SUBSTITUTIONS

- .1 If Bidders wish to propose product substitutions during the Bid period, Bidders must adhere to the requirements of Section 01 25 00 - Substitution Procedures, and submit their proposed substitution at least **7 days before Bid Closing Date**. When a request to use a substitution is made, the County may, in its sole discretion, approve the proposed substitution and, in such circumstances, will issue an Addendum to all registered Bidders through the County's bidding system at [www.bids.brant.ca](http://www.bids.brant.ca)
- .2 All work/products shall conform to the current County of Brant Development and Engineering Standards.

## 11. ACCEPTANCE OR REJECTION OF TENDERS

- .1 Tender review and award is governed County of Brant's Purchasing Policy By-Law No. 87-22 and informed by CCDC 23 – 2018 A Guide to Calling Bids and Awarding Contracts.
- .2 The submission of Tenders does not obligate the County to accept any Tender, to award the Contract or to proceed with the Project. The County may, at its sole discretion, elect not to proceed with the proposed Project in whole or in part and may, in its sole discretion, elect not to accept any or all Tenders for any reason or to cancel the Project without any obligation whatsoever to Bidders.
- .3 The County will reject Tenders containing Material Irregularity, as determined by the County in its sole discretion.
- .4 In the event of any inconsistency or mathematical error between a unit price and an extended price based upon an estimated quantity, the unit price shall be deemed to be correct, inconsistency or mathematical errors such that the Bid Price is not the sum of amounts bid for the individual items, the amounts bid for the individual items shall be deemed to be correct and the Bid Price shall be corrected accordingly.
- .5 Compliant Tenders will be rated according to Bid Price, with the lowest compliant bidder ranking first, and so on.
- .6 Acceptance of a Tender and Award of the Contract will be by the issuance of an award letter from the County to the Successful Bidder.
- .7 In addition to any other rights reserved to the County, the County reserves the right, privilege, entitlement and absolute discretion for any reason whatsoever to
  - accept a tender which is not the lowest Bid,
  - reject a Tender which is the lowest Bid, even if it is the only Tender received,
  - cancel the Request for Tender at any time, either before or after the Bid Closing Date and Time,
  - accept or reject any and all Tenders, whether in whole or in part,
  - except in the case of a Material Irregularity, accept an Irregular Tender,
  - award any part of a Tender or to award the Contract on a lot, unit or item basis; and
  - accept or reject an unbalanced Tender.



- .8 The County further reserves the right, in its sole and absolute discretion, to accept or reject any Tender which in the County's sole opinion, is irregular because it is informal, incomplete, obscure, conditional or qualified, or which has erasures, alterations or corrections, or otherwise does not fully comply with the minor or technical requirements of the Bid Documents, and to waive any formalities, technical defects, irregularities and omissions in a Bid, if in so doing, the best interest of the County will be served.
- .9 The County may, at its sole and absolute discretion, independently verify any information in any Tender. The County reserves the right to disqualify any Bidder whose Tender contains any false or misleading information in the opinion of the County, in the County's absolute discretion.
- .10 The County shall have the right in its absolute discretion, to disqualify a Bidder, or to reject a Tender, if the Bidder, or any of the Bidder's principals or subcontractors have been suspended or banned through the County's Bidder Performance Process, unless prior approval by Legal Services and/or Council has been received.
- .11 The County shall have the right in its absolute discretion to disqualify a Bidder, or to reject a Tender, if the Bidder or any of the Bidder's principals or Subcontractors, either directly or indirectly, through a corporation or personally, are or have been engaged in any legal proceedings against the County, or with which the County is in contemplation of litigation or against whom the County has a claim or instituted a legal proceeding with respect to any previous contract, without prior approval by Legal Services and/or Council.
- .12 The County shall have the right to seek further information and/or clarification, including without limitation a detailed price breakdown, from any Bidder after the Bid Closing Time, for the purposes of assisting the County in interpreting and evaluating any Bid and in interpreting any inconsistencies which may appear in any Bid, and the County shall have the right to consider and rely on such further information and clarifications in evaluating the Bid and awarding the Contract.
- .13 If all qualified Bids, as determined by the County in its sole discretion, exceed the amount that the County has budgeted for this project, the County reserves the right, privilege, entitlement and absolute discretion for any reason whatsoever to reject all bids and enter into negotiations with one or more qualified Bidders in order to obtain a lower price that is within the County's construction budget, with or without adjusting the scope of work.
- .14 The tender for this project will be submitted to the County of Brant.
- .15 The County reserves the right to reject any or all tenders or to accept any tender should it be deemed in the interest of the County to do so.
- .16 **The following may be cause for the rejection of bids:**
  1. **No Consent of Surety documentation submitted.**
  2. **No Bid Bond submitted.**
  3. **Bid Form not filled out and signed.**
  4. **Addenda not acknowledged.**
  5. **Information Submittal Forms not submitted, initialed and signed.**
  6. **Wage Rates Form not submitted and signed.**

## 12. TENDER ACCEPTANCE PERIOD

- .1 All Tenders shall be valid, irrevocable and open for acceptance for a period of sixty (60) days from the Bid Closing Date. All prices shall remain firm for the duration of the Contract and are subject to acceptance within sixty (60) days from the Bid Closing Date and Time.

## 13. CONTRACT

- .1 If notified that its Tender has been accepted by the County, the Successful Bidder shall execute the written CCDC 2 Contract identified in the Bid Documents, together with duly executed originals of the following documents;
  - Insurance Certificates required by the Contract;
  - WSIB Clearance Certificate;
  - Copy of Bidder's Occupational Health and Safety Policy;
  - Bonds; and
  - All other specific documents set out in the Bid Document.
- .2 Failure to provide such documents may result in cancellation of an award.
- .3 The **method of project delivery is CCDC 2 Stipulated Price Contract** as amended by the requirements of Section 00 80 00 - Supplementary Conditions and the SPECIAL PROVISIONS of this Request for Tender.

## 14. LAWS AND REGULATIONS

- .1 By submitting a Tender, Bidders confirm that they are familiar with, and will abide by, all Federal, Provincial, Municipal and Local laws, rules, By-laws and regulations which in any way affect the Contract work. Bidders shall report any provisions in the Bid Documents, including without limitation, drawings, specifications and other Contract Documents, that are contrary to, or inconsistent with, any law, rule, By-law or regulation, to the County in writing.
- .2 Bidders expressly acknowledge and agree that this Request for Tender and all information contained in a tender, is subject to and shall comply with all Federal, Provincial and other laws applying thereto including, but not limited to the *Municipal Act* and the *Municipal Freedom of Information and Protection Act*.

## 15. PAYMENT

- .1 The County of Brant method of payment shall be electronic funds transfer (EFT).
- .2 Any bidder receiving an award shall complete the County's EFT payment form as part of the intent to award process. This can be obtained by contacting [AP@brant.ca](mailto:AP@brant.ca)

## **16. AODA ACCESSIBILITY STANDARDS**

- .1 Under the Accessibility for Ontarians with Disabilities Act (AODA), current published version, the Proponent providing the services contemplated herein shall ensure that every person in relation to this contract, who deals with members of the public or other third parties on behalf of the County, or provides goods, services or facilities on behalf of the County, has received all training required under Section 7 of Ontario Regulation 191/11, Integrated Accessibility Standards.

## **17. MUNICIPAL FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT**

- .1 The information submitted in response to this Bidding Opportunity will be managed in accordance with all applicable legislation governing municipal activity, including but not limited to the Municipal Freedom of Information and Protection of Privacy Act (MFIPPA). The Vendor does, by the submission of a proposal, accept that the information contained in the Vendor's submission will be treated in accordance with the process set out in the document. Vendors should clearly indicate in their submission which parts, if any, are exempt from disclosure by the County of Brant under the relevant freedom of information and protection of privacy legislation.
- .2 Any submitted proposal shall immediately become the property of the County of Brant. In the course of the project or of the Bidding process, the County of Brant may provide information to vendors to allow the preparation of a response to the Bidding Opportunity or of the project deliverables. The County of Brant retains the ownership of and reserves all rights (including copyright and other intellectual property rights) in any document, materials or other information that they provide to the vendors. Vendors may not use any information provided by the County of Brant for purposes other than those for which the information was provided without the written permission of the County of Brant.

## **18. FORCE MAJEURE**

- .1 "Force majeure" means causes beyond a party's control which are not avoidable by the exercise of reasonable foresight.
- .2 Neither party shall be responsible for any delay or failure to perform its obligations under this agreement by reason of force majeure. If either party is unable to perform any of its obligations in this Contract by reason of force majeure, including fire or other casualty, strike, order of a public authority, Act of God, or other cause beyond the reasonable control of such party, then such party shall be excused from such performance of the Contract for the duration of such cause. However, lack of finances or shortage of labour is not Force Majeure. Should the performance of the Contract be delayed or prevented as herein set forth, the party that encounters such difficulty agrees to give immediate notice and explanation of the course and probable duration of any such delay to the other party. THE COUNTY OF BRANT and the Successful Bidder shall use their reasonable commercial efforts to manage

the work to minimize delays caused by any events that are referred to in this paragraph.

- .3 In the event such inability to perform shall continue longer than thirty (30) days, either party may terminate this agreement without further liability by giving written notice to the other party.

## **19. BID PRICE BREAKDOWN**

- .1 The Lowest Bidder agrees to provide a general analysis of their Bid Price and Alternate Prices, prior to award of Contract, in the form requested in Appendix C or in whatever form the Consultant on behalf of the County may reasonably request, this must be submitted 48 hours after the bid closing date and time and be submitted to [brantpurchasing@brant.ca](mailto:brantpurchasing@brant.ca) The consultant on behalf of the county reserves the right to approve and ask for revisions to bid analysis. Once approved, the analysis will form part of the "Schedule of Values" referred to in CCDC2 GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT.

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**County of Brant  
Operations Department - Public Works**

**Tender No. CPS-RFT-25-03  
North Paris Fire Station**

**SPECIAL PROVISIONS**

**.1 Special Provisions – General**

Special Provisions are included in these documents to provide instructions that may not be addressed by the General Conditions, Supplementary Conditions, Specifications and Drawings.

Where there is disagreement between the General Conditions, Supplementary Conditions, Specifications and Drawings, and Special Provisions, the Special Provisions shall take precedence.

**.2 Progress of the Work and Time for Completion**

The Contractor shall diligently execute work of Contract to complete the work before **March 10th, 2027**.

The Contractor shall be required to submit to the County, a schedule of work in accordance with the requirements of Section 01 32 16 - Construction Schedule, clearly indicating the estimated progress of work before commencing operations.

If the duration of the contract specified is not sufficient to permit completion of the work by the Contractor working a normal number of hours each day or week on a single daylight shift basis, the Contractor is expected to add additional and/or augment daylight shifts to the extent deemed necessary by the Contractor to ensure that work will be completed within the time limit specified. Any additional costs associated with compliance with these provisions will be considered to be included in the unit price for the various items of work and no additional compensation will be entertained.

Working time shall continue to accrue until the date of substantial performance of the work by the Contractor, at which time all work required in the Contract, including all final clean-up and trimming shall be completed.

Once the successful Contractor has begun work on any one part, he will not be allowed to leave the site until all work has been completed or special permission has been granted by the County and/or Contract Administrator.

**.3 Hours of Work**

The hours of work shall apply as follows:

- a. Work shall not commence prior 7:00 AM.

- b. Work shall be completed fully by 7:00 PM.
- c. Saturday work will only be permitted with written permission of the County and shall not commence before 9:00 AM in residential areas.
- d. No night work (7:00 PM to 7:00 AM) or work on Sundays or Statutory Holidays will be permitted except in the case of emergency and then only to such an extent as deemed advisable and with the written permission of the County.

The Contractor is hereby advised that By-Law Number 185-00 "A By-Law to Control Noise" shall be in place and enforced throughout the life of the Contract. The by-law is available for public viewing at the County of Brant, Burford Office.

#### **.4 Extension Time**

An extension of time for Hours of Work may be granted in writing by the County in the event of the work being delayed beyond the prescribed time for completion, such extensions shall be for such time as the County may prescribe and the County shall fix the terms on which the said extension may be granted. An application for an extension of time shall be made in writing by the Contractor to the County at least fifteen (15) business days prior to the date of completion determined by the Contract.

#### **.5 Clarification**

It will be the Contractor's responsibility to clarify any details in question not mentioned in this Contract or shown on the accompanying plans, before submitting their bid.

#### **.6 Indemnification**

The Contractor, both during and after the term of this Agreement, shall at all times, and at its own cost, expense and risk, defend, indemnify and hold harmless the Corporation of the County of Brant, its elected officials, officers, employees, volunteers, agents, contractors, and all respective heirs, administrators, executors, successors, and assigns from any and all losses, damages (including, but not limited to, incidental, indirect, special and consequential damages, or any loss of use, revenue or profit by any person, organization or entity), fines, penalties and surcharges, liabilities (including but not limited to, any and all liability for damage to property and injury to persons, including death), judgement, claims, demands, causes of action, contracts, suits, actions or other proceedings of any kind (including, but not limited to proceedings of a criminal, administrative or quasi criminal nature) and expenses (including, but not limited to, legal fees on a substantial indemnity basis), which the indemnified person or persons may suffer or incur, howsoever caused, arising out of or in consequences of or directly or indirectly attributable to the Services required to be performed by the Contractor, its agents, employees and sub-contractors on behalf of the Corporation of the County of Brant, provided such losses, damages, fines, penalties and surcharges, liabilities, judgements, claims, demands, causes of action, contracts, suits, actions or other proceedings of any

kind and expenses as defined above are due or claimed to be due to the negligence, breach of contract, and/or breach of law of the Contractor, its agents, employees or sub-contractors.

#### **.7 Liquidated Damages, Inspection and Testing Costs**

It is agreed by the parties of the Contract that in case all the work called for under the Contract is not finished or completed within the number of working days as set forth in the Tender Form, damage will be sustained by the County and that it is and will be impracticable and extremely difficult to ascertain and determine the actual damage which the County will sustain in the event of and by any reason of such delay and the parties hereto agree that the Contractor will pay to the County the sum of **Two Thousand Dollars (\$2,000.00)** per work day for Liquidated Damages for each and every calendar day's delay in finishing the work in excess of the number of working days prescribed and it is agreed that this amount is an estimate of the actual damage to the County which will accrue during the period in excess of the prescribed number of working days. The County may deduct any amount due under this paragraph from any monies that may be due or payable to the Contractor on any account whatsoever. The Liquidated Damages payable under this paragraph are in addition to and without prejudice to any other remedy, action or other alternative that may be available to the County.

The Contractor shall not be assessed with Liquidated Damages for any delay caused by Acts of God, or of the Public Enemy, Acts of the Province or of any Foreign State, Fire, Flood, Epidemics, Quarantine restrictions, Blockades, Civil Commotions, Embargoes or delays of Sub-Contractors due to such causes.

If the time available for the completion of the work is increased or decreased by reason of alterations or changes requested by the Owner and approved under General Conditions (not including delay notices or requests), the Completion Date shall be increased or decreased as determined by the County.

If during the construction of the works, deficiencies or sub-standard works are found that require additional inspection or testing to be performed while the deficiencies or sub-standard works are corrected, the County may deduct the cost of providing inspections and testing on these works (per GC 8.02.03.11).

The Corporation may deduct any amount due under this paragraph from any monies that may be due or payable to the Contractor on any account whatsoever. The liquidated damages, inspection costs or testing costs payable under this paragraph are in addition to and without prejudice to any other remedy, action or other alternative that may be available to the Corporation.



## **Invoice Format**

The County / Contract Administrator shall create the Payment Invoice for use when appropriate. This allows the County to track items paid for in our asset management and TCA system. It will be set up to follow the items in the Request for Tender for ease of review by the Contractor and County / Contract Administrator.

An invoice submitted for payment for work completed will include the following:

- Date
- Invoice Number
- Purchase Order Number (if applicable)
- Project Name and Project Location(s)
- Original Contract Amount
- Total Approved Change Orders
- Revised Contract Amount
- Completed to Date Amount
- Total Amount of Previous Billings and Chronological Record of Previous Billings
- Current Billing
- Statutory Holdback
- Statutory Declaration Repayment of Subcontractors and Materials
- Current WSIB Certificate
- Holdback Released
- Holdback Held
- Subtotal
- HST
- Total Current Billing
- Cost Breakdown with Percentage of Completion where applicable
- List of Approved Change Orders

## **.8 Fair Wage Policy**

The successful Contractor shall adhere to the most current version of the Ontario Fair Wage Policy and all applicable schedules. The Contractor shall also ensure adherence to said policy by all sub-contractor used in connection with this contract.



## **.9 Workplace Safety and Insurance Board**

The successful Contractor must provide the County of Brant with a current WSIB Clearance Certificate specific to the type of work being performed prior to the start of work. If the owner of the successful company is involved in the day-to-day operation of the company and will be present on site at any time during the term of this agreement, proof of optional insurance through WSIB must be also submitted in combination with the standard Clearance Certificate (as required by WSIB). A copy of the current WSIB Clearance Certificate must be submitted with every request for payment.

If any persons will be present on site to perform work related to this Contract other than those employed directly by the successful Contractor (eg: temporary services), a current WSIB Clearance Certificate, specific to the type of work being performed, must be submitted to the County of Brant prior to these person(s) entering the site. If the owner of said company or organization will be involved in any work related to this agreement, proof of optional insurance through WSIB must also be submitted in combination with the standard Clearance Certificate (as required by WSIB). A new WSIB Clearance certificate must be submitted for said company or organization at sixty (60)-day intervals (upon expiration) throughout the entire duration of the Contract. A copy of the current WSIB Clearance Certificate must be submitted with every request for payment.

## **.10 Liabilities and Responsibilities**

The Contractor, for the purpose of this Tender, is responsible for his own adherence to the Ministry of Labour, the Construction Safety Act, the Industrial Safety Act and any other Acts and Regulations as applicable. The Contractor agrees that he will comply with the Occupational Health and Safety Act, R.S.O. 1990, Chapter O.1 and Regulations and amendments thereto and will be responsible for the compliance therefore of any of his drivers or employees, while working on this Contract.

All persons working on this job are to comply with all Brant County Health and Safety Policies and Procedures, a copy of which can be obtained from the County of Brant, Burford Office.

## **.11 Contractor as Constructor**

- .1 The Contractor acknowledges that, if the County does not enter into any other contracts for the project, the Contractor is the “constructor” and the “employer” within the meaning of the Occupational Health and Safety Act (Ontario) and the Contractor undertakes to carry out the duties, obligations and responsibilities of the “constructor” and the “employer” with respect to the Project. The County may have cause to enter into more than one contract for the Project. Additionally, there may be instances where the County’s staff are required to attend the project site for specified intervals to perform work associated with the Project. In such cases, the Contractor is required and agrees to fulfill all of the duties, obligations and responsibilities of the “constructor” and “employer” with respect to the project and on behalf of the County, in accordance with the terms and conditions set out in the Contract, and in accordance with the following requirements for the Contractor when other contractors of the County’s staff/other contractors are required to attend the Project site to perform work associated with the project.
  - a) The Contractor shall assume and fulfill the responsibility of constructor for all County’s staff/other contractors attending the Project site to conduct work;
  - b) The Contractor shall provide orientation to the County’s staff/other contractors prior to work commencement at the site;
  - c) The Contractor shall identify a site supervisor contact or assistant for all County staff/other contractors.
- .2 The Contractor shall maintain a sign in/out log of all visitors to the site, including the County’s staff/other contractors.
- .3 The Contractor shall, in order to avoid delays, provide sufficient notice and coordinate County’s staff/other contractors’ work so it does not impact on or conflict with any other work happening at the site;
- .4 The Contractor shall schedule County’s staff/other contractors’ work as close as possible to substantial performance to avoid the majority of construction hazards and risk to County’s staff/other contractors’ staff.
- .5 The Contractor shall maintain a log of all Form 1000 provided by each employer on site.

## **.12 Contractor’s Insurance**

It is the responsibility of the Contractor and their Insurance Broker to review all potential operations and exposures to determine if the coverage and limits noted in CCDC 41 are sufficient to address all insurance-related exposures presented in the Contract.

Without restricting the generality of the above and Indemnification, the Contractor shall provide, maintain and pay for the insurance coverages listed in General Conditions of Contract, at a minimum in accordance with CCDC 41.

### **.13 Dust and Mud Control**

The Contractor shall take such steps as may be required to prevent nuisance dust resulting from his operations either within the right-of-way or elsewhere, or by public traffic, where it is the Contractor's responsibility to maintain a roadway through the work. The cost of all such preventative measures shall be borne by the Contractor. When conditions are such that dust and mud are tracked onto adjacent streets, the Contractor will be required to clean all fouled surfaces at no cost to the County.

### **.14 Spills Reporting**

Spills or discharges of pollutants or contaminants under the control of the Contractor, and spills or discharges of pollutants or contaminants that are a result of the Contractor's operations that cause or are likely to cause adverse effects shall forthwith be reported to the Contract Administrator. Such spills or discharges and their adverse effects shall be as defined in the Environmental Protection Act of Ontario.

All spills or discharges of liquid, other than accumulated rain water, from luminaires, internally illuminated signs, lamps and liquid type transformers under the control of the Contractor, and all spills or discharges from this equipment that are a result of the Contractor's operations shall, unless otherwise indicated in the Contract, be assumed to contain PCB's and shall forthwith be reported to the Contract Administrator.

This reporting will not relieve the Contractor of his legislated responsibilities regarding such spills or discharges.

### **.15 Environment Considerations**

It is intended that the works proposed are executed in such a manner which, to the fullest possible extent, minimizes any adverse effects on the natural environment of the project area.

The environmental conditions specified by Section 01 35 43 - Environmental Requirements must be complied with in all respects. It is a responsibility of the Contractor that all his personnel be sufficiently instructed so that the work is carried out in a manner consistent with minimizing environmental impact.

### **.16 Protection of Trees During Construction**

The protection of trees not designated for removal shall be provided in accordance with OPSS 565.

If the contract requires work to be completed within the dripline of a tree or trees which are designated not to be removed, operation of equipment within the dripline area shall be kept to the minimum necessary to perform the work required.

In order to minimize root loss, the Contractor will be required to use vertical trench walls and appropriate support systems when excavating within the dripline of trees. All exposed roots over 25mm in diameter shall be cut back cleanly to the soil surface within five calendar days.

If root damage or loss is extensive, portions of the tree shall be pruned. All pruning will be carried out by a qualified and experienced landscape contractor using approved arboricultural techniques and practices. The pruning of trees and shrubs will be carried out in such a manner as to retain as much as possible of the plant's natural form. The Contractor will be responsible for disposing of cut limbs and roots in an approved manner off-site. In addition, the remaining root system shall be water and fertilized by qualified and experienced landscape contractor.

No extra payment will be made to the Contractor for vertical trenching and trench supports, pruning branches and roots, or watering and fertilizing trees when work is required within the dripline.

#### **.17 Traffic Control and Signing**

The Contractor shall implement Traffic Control measures at road(s) serving the Place of Work.

Traffic Control and Signing shall be included in the unit cost of the work and no extra money shall be paid to the Contractor unless a specific item is included in the Form of Tender for said work.

Note: A sample copy of the County of Brant's "Activity/Traffic Control Protection Plan" is included in the 'Additional Project Information Section 00 30 00' for reference.

#### **.18 Provisional Items and/or Provisional Sums**

Several tender items for this contract may be identified in this Request for Tender and Contract Documents as Provisional Items or Provisional Sums. The work to be done under such Provisional Items or Provisional Sums may be cancelled or reduced by the County at any time during the contract. The Contractor shall have no claim for loss of overhead or profit should the County decide to delete any or all work to be completed under said Provisional Items or Provisional Sums.

Provisional Items shall not be initiated without the written consent of the County of Brant.

## **.19 Utilities and Support of Existing Utilities**

The Contractor shall be responsible for contacting all local utility authorities to determine the exact locations of these utilities. The contractor shall include all costs associated with the utility locates in the respective items of work and no separate measurement or payment will be made. Furthermore, any utilities that require relocation shall be the responsibility of the Utility Company concerned.

The Contractor's attention is drawn to the fact that other Contractor's and/or personnel of public utilities or authorities may be working in the areas on or adjoining the site. It will be the Contractor's responsibility to cooperate with persons working in the aforementioned areas and such cooperation is an obligation under the terms of this contract.

The Contractor shall be responsible for the protection of all services, whether aerial, embedded or underground, including (but not limited to) telephone cables, hydro cables, cable television etc. during the time of construction and the contractor will be liable for any damage to same.

The Contractor shall hand dig to accurately locate any underground utility if required and this cost shall be included in the unit prices bid.

The Contractor shall advise the appropriate utility, when any and all work near their utility will be undertaken and maintaining direct lines of communication with each of these utilities.

## **.20 Performance Evaluation**

At the substantial performance of the Contract, the performance and or quality of the service as provided by the successful Contractor shall be rated in accordance with the County of Brant Purchasing Policy By-Law No. 45-13, section 4.0, a copy of which is included in 'Additional Project Information Section 00 30 00' or can be obtained from the County of Brant, Burford Office or from the County of Brant website at [www.brant.ca](http://www.brant.ca).

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**Part 1 General**

**1.1 DEFINITIONS**

- .1 Information Documents means information of any type and in any form, related to the Project and identified in this Section as such and do not include the Contract Documents.

**1.2 STATUS OF INFORMATION DOCUMENTS**

- .1 Information Documents, or any part thereof, are not part of the Contract unless specifically incorporated into Contract Documents by means of copying, transcribing or referencing.

**1.3 USE OF AND RELIANCE UPON INFORMATION DOCUMENTS**

- .1 Information Documents are made available to Bidder by Owner for the purpose of providing Bidder with access to information available to Owner.
- .2 Information Documents shall not be considered a representation or warranty that information contained therein is accurate, complete or appropriate, and do not form a part of the Contract Documents.
- .3 Bidder shall interpret and draw its own conclusions about Information Documents and is encouraged to obtain specialist advice with respect thereto. Prime Consultant assumes no responsibility for such interpretations and conclusions. Information contained in Information Documents may be time sensitive and dates shall be considered when interpreting Information Documents.
- .4 Bidder may rely upon the data and recommendations contained in "Information Documents", or parts thereof, that are specifically incorporated into the Contract Documents by means of copying, transcribing or referencing, but shall draw their own conclusions from such data and/or recommendations, and shall not rely on opinions or interpretations contained therein.
- .5 Contractor shall make their own determinations of the locations of services and utilities, and perform their own site surveys as required to perform the Work of Contract.

**1.4 INFORMATION DOCUMENTS**

- .1 Information Documents, in whole or in part, consist of the following, which are available to bidders via the electronic bidding system:
  - .1 Geotechnical Engineering Report, New Fire Station, Scott Avenue, Paris, ON, County of Brant, Revised Report June 25, 2025, 04-02405146.000-100-GS-R-0001-01, Prepared by Englobe Corp.
  - .2 Plan of Topographical Survey of Part of Lot 29 Concession 2 County of Brant, drawing prepared by MacAulay, White & Muir Ltd., reference no. 24-50-159-00, June 28, 2024 with additional grades added May 16, 2025.
  - .3 New North Paris Fire Station Civil Works, Functional Servicing and Stormwater Management Report, by MTE Consultants Inc., MTE File No. 55275-200, revised June 6, 2025.
  - .4 Stage 1-2 Archaeological Assessment, North Paris Fire Station, Scott Avenue, Town of Paris, Part of Lot 29, Concession 2, Geographic Township of South Dumfries, Brant County, Ontario, Original Report, prepared by TMHC Inc. Licensee: Lara Wood, MA, P1078, PIF No: P1078-0274-2024, Project No: 2024-283, Dated: June 10, 2025.
- .2 Construction Related Procedures and Forms, in whole or in part, consist of the following, which are available to bidders via the electronic bidding system:

- .1 County of Brant Water Division Information, "GUIDE FOR THE DEVELOPMENT OF A DISINFECTION AND COMMISSIONING PROCEDURE FOR MUNICIPAL DRINKING WATER INFRASTRUCTURE, PRIVATE WATER SERVICE CONNECTIONS AND PRIVATE FIRE LINES 100MM OR GREATER", prepared by County of Brant Environmental Services Water Operations, QMS reference: GD-03-17, Current Revision Date: January 22, 2025, Version Number: 11.
- .2 "Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under an Environmental Compliance Approval", Ontario Ministry of Environment, Conservation and Parks v.2.0, May 5, 2023.
- .3 County of Brant Purchasing Policy Bylaw 45-13 Schedule "C" "Vendor Performance Evaluation Form", prepared by County of Brant.
- .4 County of Brant "Activity/Traffic Control Protection Plan" Form, prepared by County of Brant.
- .5 County of Brant "Safety Hazard Checklist (To be completed at the beginning of each new job or weekly for ongoing jobs)", prepared by County of Brant.

**END OF SECTION**

**1.1 SURETY COMPANY REQUIREMENTS**

- .1 The surety company offering bonds must be licensed by the Financial Services Regulatory Authority of Ontario. Bonds so provided are to be issued by a surety company licensed to issue surety bonds in the Province of Ontario.

**1.2 CONTRACT PERFORMANCE SECURITY**

- .1 Contractor shall provide security for performance of the Contract in the form of the following:
  - .1 Performance Bond for 50% of the Contract Price.

**1.3 SECURITY FOR PAYMENT OF CLAIMS**

- .1 Contractor shall provide security for payment to claimants for labour and material used or reasonably required for use in the performance of the Contract. Such security shall be in the form of the following:
  - .1 Labour and Material Payment Bond for 50% of the Contract Price.

**1.4 FORMS OF ACCEPTABLE SECURITY**

- .1 Surety Bonds
  - .1 Performance Bond shall be in accordance with FORM 32 PERFORMANCE BOND UNDER SECTION 85.1 OF THE ACT; sample attached following this Section.
  - .2 Labour and Material Payment Bond shall be in accordance with FORM 31 LABOUR AND MATERIAL PAYMENT BOND UNDER SECTION 85.1 OF THE ACT; sample attached following this Section.
  - .3 Consign bonds to Owner.

**1.5 SUBMISSION OF SECURITY**

- .1 Submit security to the Owner with fifteen (15) days after bid is accepted.

**1.6 RELEASE OF CONTRACT PERFORMANCE BONDING**

- .1 Release of Performance Bonds will be in accordance with CCDC 2-2020.

**1.7 RELEASE OF SECURITY FOR PAYMENT OF CLAIMS**

- .1 Release of Labour and Materials Bonds will be in accordance with CCDC 2-2020.

**END OF SECTION**



**FORM 31**  
**LABOUR AND MATERIAL PAYMENT BOND UNDER SECTION 85.1 OF THE ACT**  
*Construction Act*

No. \_\_\_\_\_ (the “**Bond**”) Bond Amount \$ \_\_\_\_\_

\_\_\_\_\_  
(name of the contractor\*)

as a principal, hereinafter [collectively] called the “**Contractor**”, and

\_\_\_\_\_  
(name of the surety company\*\*)

a corporation created and existing under the laws of \_\_\_\_\_  
(place of incorporation)

as a surety, and duly authorized to transact the business of Suretyship in the Province of Ontario and hereinafter called the “**Surety**”, are held and firmly bound unto \_\_\_\_\_  
(name of the owner\*\*\*)

as obligee, hereinafter called the “**Owner**”, in the amount of \$ \_\_\_\_\_ hereinafter called the “**Bond Amount**”,  
(Bond Amount in figures)

for the payment of which sum the Contractor and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally in accordance with the provisions of this Bond (the “**Obligation**”).

WHEREAS the Contractor has entered into a written contract with the Owner dated the \_\_\_\_\_ day of \_\_\_\_\_  
(name of month)

in the year \_\_\_\_\_ for \_\_\_\_\_  
(title or description of the contract)

(the “**Original Contract**”) and, for the purpose of specifying the conditions of the Obligation, this contract together with amendments made in accordance with its terms are by reference made part hereof and are hereinafter referred to collectively as the “**Contract**”;

NOW THEREFORE the condition of this Obligation is such that if the Contractor shall make payment to all Claimants as hereinafter defined in accordance with the terms of their respective subcontracts or sub-subcontracts for all labour and material used or reasonably required for use in the performance of the Contract then this Obligation shall be null and void, otherwise it shall remain in full force and effect subject to the following conditions:

1. Every corporate or natural person, including a union or workers trust fund on behalf of unionized workers, having a direct contract with the Contractor (hereinafter called a “Subcontractor”) or with any Subcontractor (hereinafter called a “Sub-subcontractor”) for labour, material or both used or reasonably required for use in the performance of the Contract is a “Claimant” under this Bond. The entitlement under this Bond of any Sub-subcontractor, however, is limited to such amounts as the Contractor would have been obligated to pay to the Sub-subcontractor under the *Construction Act* (the “Act”). The entitlement under this Bond of any union or workers trust fund is limited to wages and monetary supplementary benefits, as defined in the Act. The terms “labour” and “material” include that part of water, gas, power, light, heat, oil, gasoline, telephone or digital service or rental equipment directly applicable to the Contract provided that a Claimant who rents equipment to the Contractor or a Subcontractor to be used in the performance of the Contract under a contract which provides that all or any part of the rent is to be applied towards the purchase price thereof shall only be a Claimant to the extent of the prevailing industrial rental value of such equipment for the period during which the equipment was used in the performance of the Contract. The prevailing industrial rental value of equipment shall be determined, insofar as it is practical to do so, by the prevailing rates in the equipment marketplace in which the work is taking place.
2. The Owner is not obligated to do or take any action or proceeding against the Surety on behalf of the Claimant to enforce the bond.

3. Every Claimant who has not been paid for labour, material or both used or reasonably required for use in the performance of the Contract, after the date on which payment was due and payable under the terms of its subcontract or sub-subcontract may demand payment under this Bond by giving the Surety, with a copy to the Contractor and the Owner, a written Notice of Claim, substantially in the form prescribed in Schedule A for a Subcontractor or Schedule B for a Sub- subcontractor, hereinafter called the **"Notice of Claim"**.
4. Where the Surety includes two or more companies a Notice of Claim may be delivered to the first listed Surety on behalf of all Sureties. The first listed Surety is hereby authorized to respond to a Notice of Claim on behalf of the Surety, and a Claimant is not required to make separate Notices of Claim to each Surety and is entitled to correspond with the first listed Surety on behalf of all Sureties.
5. It is a condition precedent to the liability of the Surety under this Bond that a Claimant shall have submitted a Notice of Claim
  - a) in respect of any amount required to be held back from the Claimant by the Contractor, or by a Subcontractor, under either the terms of the Claimant's contract with the Contractor or Subcontractor or under the *Act*, whichever is the greater, hereinafter and for the purposes of this Bond called the "Holdback", within one hundred and twenty (120) calendar days after the Claimant should have been paid in full under its contract with the Contractor or with a Subcontractor; and
  - b) in respect of any amount other than for Holdback within one hundred and twenty (120) calendar days after the date on which the Claimant last performed labour or provided materials for which the Notice of Claim was given.
6. For each Notice of Claim provided by a **Subcontractor**:
  - a) No later than three (3) business days after receipt by the Surety of a Notice of Claim the Surety shall acknowledge receipt of the Notice of Claim, substantially in the form prescribed at Schedule C, and request from the Claimant any information and documentation the Surety requires to determine the Claimant's entitlement under this Bond (hereinafter called the **"Information"**); and
  - b) No later than the earlier of: (a) ten (10) business days after receipt by the Surety of the Information, (b) twenty-five (25) business days after receipt by the Surety of a Notice of Claim, or (c) such longer time as agreed by the Surety and the Subcontractor, the Surety shall provide a position in response to the Notice of Claim, substantially in the form prescribed at Schedule D, hereinafter called the **"Surety's Position"**.
7. For each Notice of Claim provided by a **Sub-subcontractor**:
  - a) No later than three (3) business days after receipt by the Surety of a Notice of Claim the Surety shall acknowledge receipt of the Notice of Claim, substantially in the form prescribed at Schedule C, and request from the Claimant any information and documentation the Surety requires to determine the Claimant's entitlement under this Bond (hereinafter called the **"Information"**); and
  - b) No later than the earlier of: (a) fifteen (15) business days after receipt by the Surety of the Information, (b) thirty-five (35) business days after receipt by the Surety of a Notice of Claim, or (c) such longer time as agreed by the Surety and the Sub-subcontractor, the Surety shall provide a position in response to the Notice of Claim, substantially in the form prescribed at Schedule D, hereinafter called the **"Surety's Position"**.
8. No later than ten (10) business days after the Surety's Position being provided to any Claimant the Surety shall pay such amounts included in the Notice of Claim that are undisputed by the Surety, except to the extent that the Surety makes an application to the Court with respect to such amounts in accordance with Section 12 below. This payment of undisputed amounts shall be without prejudice to the Surety's position regarding any disputed portions of a Notice of Claim.
9. If the subject matter of a notice of adjudication which is delivered in accordance with the *Act* by the Contractor or a Claimant (the **"Notice of Adjudication"**) is substantially the same as that contained in a Notice of Claim, the obligations of the Surety under this Bond shall be stayed until the Surety receives a copy of the adjudicator's determination or there is otherwise a failure to complete or a termination of the adjudication under Section 13.14 of the *Act*.
10. By submitting a claim under this Bond, a Claimant agrees that, in the event of an adjudication between itself and the Surety pursuant to which the Surety pays the Claimant pursuant to an adjudicator's interim binding determination, the Surety shall be entitled to bring an action against the Claimant to obtain a final and binding decision in respect of the Claimant's entitlement under this Bond.
11. The Surety shall not in any circumstances be liable for a greater sum than the Bond Amount.
12. The Bond Amount shall be reduced by and to the extent of any payment or payments made under this Bond. If the aggregate of all Notices of Claim exceed, or the aggregate of amounts for which Notices of Claim might be given are believed by the Surety to exceed, the Bond Amount then the Surety may apply to the Court for direction in the interest of all Claimants.

13. Upon payment to a Claimant under this Bond in respect of any indebtedness of the Contractor or Subcontractor to the Claimant, the Surety shall be subrogated to all of the rights of the Claimant in respect of any and all claims, causes of action and rights to recovery which the Claimant may have against any person, firm or corporation because of or in connection with or arising out of such indebtedness, and the Claimant undertakes to extend to the Surety or the Surety's designee any warranties and/or guarantees under the Contract in respect of all labour and materials for which the Claimant has been paid.
14. As a condition precedent, any suit or action under this Bond must be commenced within one (1) year after the date on which the Contractor last performed work on the Contract, including work performed under any warranty or guarantees provided in the Contract.
15. The parties to this Bond and a Claimant by providing a Notice of Claim agree that any suit or action is to be made to a court of competent jurisdiction in Ontario and agree to submit to the jurisdiction of such court notwithstanding any terms to the contrary in the Contract.
16. The rights and obligations of the Owner, the Contractor, and the Surety under this Bond are in addition to their respective rights and obligations at common law and in equity.
17. This Bond shall be governed by the laws of the Province of Ontario.
18. All notices ("Notices") under this Bond shall be delivered by registered mail, facsimile, or electronic mail at the addresses set out below, subject to any change of address in accordance with this Section. Any Notice given by facsimile or electronic mail shall be deemed to have been received on the next business day or, if later, on the date actually received if the person to whom the Notice was given establishes that he or she did not, acting in good faith, receive the Notice until that later date. Any Notice given by registered mail shall be deemed to have been received five (5) days after the date on which it was mailed, exclusive of Saturdays and holidays or, if later, on the date actually received if the person to whom the Notice was mailed establishes that he or she did not, acting in good faith, receive the Notice until that later date. A change of address for the Surety shall be publicly available on the Financial Services Regulatory Authority of Ontario website. The address for the Owner or the Contractor may be changed by giving Notice to the other parties setting out the new address in accordance with this Section.

**The Surety:**

[Surety corporate name]  
[address]  
[fax]  
[email]

**The Owner:**

[Owner proper name]  
[address]  
[fax]  
[email]

**The Contractor:**

[Contractor corporate name]  
[address]  
[fax]  
[email]

**IN WITNESS WHEREOF**, the Contractor and the Surety have Signed and Sealed this Bond this \_\_\_\_\_ day of \_\_\_\_\_ in the year \_\_\_\_\_.

[Contractor proper name]

Witnessed by :

By: \_\_\_\_\_

\_\_\_\_\_

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

Name of Witness: \_\_\_\_\_

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

Address of Witness: \_\_\_\_\_

I have authority to bind the corporation.

[Surety corporate name]

By: \_\_\_\_\_

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

Attorney-in-fact

**\* IF THERE ARE TWO OR MORE COMPANIES IN PARTNERSHIP OR JOINT VENTURE, JOINTLY AND SEVERALLY BOUND, INSERT THE NAME OF EACH PARTNER OR JOINT VENTURE PARTY, AND INSERT THE WORD "COLLECTIVELY" AFTER THE WORD "HEREINAFTER" IN THE FIRST LINE.**

**\*\* IF THERE ARE TWO OR MORE SURETY COMPANIES, JOINTLY AND SEVERALLY BOUND, INSERT THE "[Name of the surety company], a corporation created and existing under the laws of [Place of incorporation]," FOR EACH SURETY, FOLLOWED BY "each as a surety and each duly authorized to transact the business of Suretyship in the Province of Ontario and hereinafter collectively called the "Surety"".**

**\*\*\* INSERT THE CROWN, A MUNICIPALITY OR A BROADER PUBLIC SECTOR ORGANIZATION, AS APPLICABLE, OR SUCH OTHER PARTY DEEMED TO BE THE OWNER UNDER THE ACT, AND ENTERING INTO THE PUBLIC CONTRACT WITH THE CONTRACTOR.**

**SCHEDULE A**  
Notice of Claim  
[Subcontractor]

[date]

[Surety name]

[Surety address]

[Surety address]

[Surety's electronic/email address]

**Attention:**

Re: \_\_\_\_\_

Bond No: \_\_\_\_\_

Contractor: \_\_\_\_\_

Owner: \_\_\_\_\_

Contract: \_\_\_\_\_

Dear Sir/Madam,

We have a subcontract with the Contractor for \_\_\_\_\_  
(title or description of the Contract)

(our "Subcontract") related to the Contract between the Owner and the Contractor for

\_\_\_\_\_ in \_\_\_\_\_  
(town/city, province)

We have given notice to the Contractor as required under our Subcontract that an amount is due and payable under the Subcontract and remains unpaid contrary to the terms of the Subcontract.

For Holdback amounts we hereby demand payment of \$ \_\_\_\_\_ under the captioned Bond.

For amounts other than Holdback we hereby demand payment of \$ \_\_\_\_\_ under the captioned Bond for all labour and material used or reasonably required for use in the performance of the Contract.

To assist in your evaluation of this Notice of Claim we invite you to contact our representative as follows:

[Name]

[Title]

[Company address]

[Phone (mobile)]

[Email address]

We also enclose the following documents supporting our Notice of Claim:

*[The following is a suggested list of documents to be considered for delivery to the Surety. Please check off the documents (if any) that you are providing with this Notice of Claim.]*

- ☐ Copy of full, executed Subcontract [or Purchase Order or Collective Bargaining Agreement], including approved changes and pending changes relevant to this Notice of Claim
- ☐ Copy of the prime contract between the Contractor and the Owner
- ☐ Copy of original schedule and latest approved schedule for the Subcontract
- ☐ Copies of all invoices submitted to the Contractor
- ☐ Copies of all payments from the Contractor to the Claimant

- ☐ Summary reconciliation of all invoices issued under the Subcontract
- ☐ Summary reconciliation of all payments received under the Subcontract
- ☐ Confirmation from the Owner or Contractor that the Claimant has completed all of its work including rectification of all identified deficiencies and the delivery of all required close-out documents
- ☐ Copy of any notice or correspondence to and from the Contractor relevant to this Notice of Claim
- ☐ Confirmation of the last day the Claimant performed work pursuant to the Subcontract including proof thereof
- ☐ Copy of any claim for lien, legal proceeding or other documents to enforce your entitlement to payment
- ☐ Copy of the executed Labour and Material Payment Bond under which this Notice of Claim is being made
- ☐ [additional documents]

We look forward to receiving your acknowledgment of this Notice of Claim within three (3) business days of receipt and your request for any additional documentation or information you require to meet your obligations under the Bond.

Yours truly;

**[Full corporate title]**

By: \_\_\_\_\_

**[Name]**

**[Title]**

**[Phone]**

**[Email address]**

CC: **[Contractor]**

**SCHEDULE B**  
Notice of Claim  
[Sub-subcontractor]

[date]

[Surety name]

[Surety address]

[Surety address]

[Surety's electronic/email address]

**Attention:**

Re: \_\_\_\_\_

Bond No: \_\_\_\_\_

Contractor: \_\_\_\_\_

Subcontractor \_\_\_\_\_

Owner: \_\_\_\_\_

Contract: \_\_\_\_\_

Dear Sir/Madam,

We have a written subcontract with \_\_\_\_\_ (the "Subcontractor") for  
(name of the subcontractor)

\_\_\_\_\_ (our "Subcontract") related to the Contract  
(title or description of the Sub-subcontract)

between the Owner and the Contractor for \_\_\_\_\_ in  
(title or description of the Contract)

\_\_\_\_\_.  
(town/city, province)

We have given notice under our Sub-subcontract to the Subcontractor that an amount is due and payable under the Sub-subcontract and remains unpaid contrary to the terms of the Sub-subcontract. A copy of that notice has also been provided to the Contractor.

We hereby demand payment of \$ \_\_\_\_\_ under the captioned Bond.

To assist in your evaluation of this Notice of Claim we invite you to contact our representative as follows:

[Name]

[Title]

[Company address]

[Phone (mobile)]

[Email address]

We also enclose the following documents supporting our Notice of Claim:

*[The following is a suggested list of documents to be considered for delivery to the Surety. Please check off the documents (if any) that you are providing with this Notice of Claim.]*

- ☐ Copy of full, executed Sub-subcontract [or Purchase Order or Collective Bargaining Agreement], including approved changes and pending changes relevant to this Notice of Claim
- ☐ Copy of the prime contract between the Subcontractor and the Contractor
- ☐ Copy of original schedule and latest approved schedule for the Sub-subcontract
- ☐ Copies of all invoices submitted to the Subcontractor

- ☐ Copies of all payments from the Subcontractor to the Claimant
- ☐ Summary reconciliation of all invoices issued under the Sub-subcontract
- ☐ Summary reconciliation of all payments received under the Sub-subcontract
- ☐ Confirmation from the [Owner, Contractor or Subcontractor] that the Claimant has completed all of its work including rectification of all identified deficiencies and the delivery of all required close-out documents
- ☐ Copy of any notice or correspondence to and from the Subcontractor or Contractor relevant to this Notice of Claim
- ☐ Confirmation of the last day the Claimant performed work pursuant to the Sub-subcontract including proof thereof
- ☐ Copy of any claim for lien, legal proceeding or other documents to enforce your entitlement to payment
- ☐ Copy of the executed Labour and Material Payment Bond under which this Notice of Claim is being made
- ☐ [additional documents]

We look forward to receiving your acknowledgment of this Notice of Claim under the Bond and your request for any additional documentation or information you require to meet your obligations under the Bond.

Yours truly;

**[Full corporate title]**

By: \_\_\_\_\_

**[Name]**

**[Title]**

**[Phone]**

**[Email address]**

CC: **[Contractor and Subcontractor]**



**SCHEDULE C**  
Acknowledgement of Notice of Claim

[date]

[Name/corporate title of the Subcontractor or Sub-subcontractor]

[Address]

[Address]

[E-mail address (if provided in the Notice of Claim)]

Attention:

Re: \_\_\_\_\_

Bond No: \_\_\_\_\_

Contractor: \_\_\_\_\_

Owner: \_\_\_\_\_

Contract: \_\_\_\_\_

Dear Sir/Madam,

We acknowledge receipt on \_\_\_\_\_ of your Notice of Claim dated \_\_\_\_\_.  
(date of receipt)

Subject to a full reservation of all of our rights pursuant to the Bond and at law and to assist us in evaluating your Notice of Claim we ask that you provide the following information and/or documentation promptly:

This request for information is not an acknowledgement of the validity of your claim. We look forward to hearing from you.

Yours truly;

[Corporate name of the Surety]

By: \_\_\_\_\_

[Name]

[Title]

[Phone]

[Email address]

CC: [Contractor]

**SCHEDULE D**  
Surety's Position

[date]

[Name/corporate title of the Subcontractor or Sub-subcontractor]

[Address]

[Address]

[E-mail address (if provided in the Notice of Claim)]

Attention:

Re: \_\_\_\_\_

Bond No: \_\_\_\_\_

Contractor: \_\_\_\_\_

Owner: \_\_\_\_\_

Contract: \_\_\_\_\_

Dear Sir/Madam,

Having reviewed the information and documentation provided to us in support of your Claim, we can advise as follows:

**A – Disputed Amount(s)**

The following amounts in your Claim are disputed at the present time for the reasons indicated:

With respect to any disputed amounts we invite you to contact us promptly with further information or documentation in support of your Claim.

**B – Undisputed Amount(s)**

The following amounts in your Claim are not disputed at the present time, however we reserve the right to dispute any amount should an ultimate determination find that amounts included in your Claim were not payable by the Contractor:

We continue to reserve all of our rights pursuant to the Bond and at law.

If you have any questions or concerns, please do not hesitate to contact us.

Yours truly;

[Corporate name of the Surety]

By: \_\_\_\_\_

[Name]

[Title]

[Phone]

[Email address]

CC: [Contractor]

**FORM 32**  
**PERFORMANCE BOND UNDER SECTION 85.1 OF THE ACT**

*Construction Act*

No. \_\_\_\_\_ (the “**Bond**”) Bond Amount \$ \_\_\_\_\_

\_\_\_\_\_  
(name of the contractor\*)

as a principal, hereinafter [collectively] called the “**Contractor**”, and

\_\_\_\_\_  
(name of the surety company\*\*)

a corporation created and existing under the laws of \_\_\_\_\_  
(place of incorporation)

as a surety, and duly authorized to transact the business of Suretyship in the Province of Ontario and hereinafter called the “**Surety**”, are held and firmly bound unto \_\_\_\_\_

(name of the owner\*\*\*)

as obligee, hereinafter called the “**Owner**”, in the amount of \$ \_\_\_\_\_ hereinafter called the “**Bond Amount**”,  
(Bond Amount in figures)

for the payment of which sum the Contractor and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally in accordance with the provisions of this Bond (the “**Obligation**”).

WHEREAS the Contractor has entered into a written contract with the Owner dated the \_\_\_\_\_ day of \_\_\_\_\_  
(name of month)

in the year \_\_\_\_\_ for \_\_\_\_\_  
(title or description of the contract)

(the “**Original Contract**”) and, for the purpose of specifying the conditions of the Obligation, this contract together with amendments made in accordance with its terms are by reference made part hereof and are hereinafter referred to collectively as the “**Contract**”;

NOW THEREFORE the condition of this Obligation is such that if the Contractor shall promptly and faithfully perform the Contract then this Obligation shall be null and void; otherwise it shall remain in full force and effect, subject to the following terms and conditions:

**1. Written Notice**

- 1.1 The Owner may make a written demand on the Surety in accordance with this Bond, by giving notice to the Surety substantially in the form attached as Schedule A (the “**Notice**”). Except for a Pre-Notice Meeting in accordance with Section 2.1, the Surety shall have no obligation under this Bond until it receives a Notice.
- 1.2 Where the Surety includes two or more companies, the Notice may be delivered to the first listed Surety on behalf of all Sureties. The first listed Surety is hereby authorized to respond to the Notice on behalf of the Sureties, and the Owner is not required to give separate Notice to each Surety and is entitled to correspond with the first listed Surety on behalf of all Sureties.

**2. Pre-Notice Meeting**

- 2.1 The Owner may, at its sole discretion and acting reasonably, request a pre-Notice conference by notifying the Surety and the Contractor in writing that it is considering declaring the Contractor to be in default under the Contract (the “Pre-Notice Meeting”). This notice and request for a Pre-Notice Meeting by the Owner does not constitute a Notice under this Bond, nor under the Contract, nor is it a precondition to the giving of a Notice. Upon receipt of such request the Surety shall propose a face-to-face meeting, a telephone conference call or a meeting by any other form of electronic media between the Contractor, the Owner and the Surety to take place

at a time and place mutually convenient for all parties within seven (7) business days (or such longer time as agreed by all parties) after the Surety's receipt of the Owner's request for a Pre-Notice Meeting in accordance with this Section. The Owner, the Contractor and the Surety shall make reasonable efforts to arrange and attend the Pre-Notice Meeting. In the event that the Owner delivers a Notice prior to the Pre-Notice Meeting, then the Pre-Notice is deemed to be retracted.

- 2.2 The purpose of a Pre-Notice Meeting is to allow the Owner, prior to exercising its other rights under this Bond, to express any concerns about the Contractor's performance pursuant to the Contract and to allow the Contractor to respond to such concerns. The participation of the parties in one or more Pre-Notice Meetings shall be without prejudice to their respective rights and obligations under the Contract, this Bond or applicable law, and neither the participation by any party in any Pre-Notice Meeting, nor any statement or position taken or information provided by any party during any Pre-Notice Meeting, may be relied on by any other party as a waiver or compromise of the rights or obligations of the Owner, the Surety or the Contractor under the Contract, this Bond or applicable law; including, but not limited to the Owner's right to declare the Contractor in default under the Contract and give Notice under this Bond.

### **3. Surety's Investigation and Response**

- 3.1 Upon receipt of a Notice from the Owner, the Surety shall promptly initiate an investigation of the Notice (the "**Investigation**"), using its best efforts, to determine if the Conditions Precedent have been satisfied and to determine its liability, if any, under the Bond.
- 3.2 Within the four (4) business days following receipt of the Notice, the Surety shall provide the Owner with an acknowledgement, substantially in the form set out as Schedule B (the "**Acknowledgement**"), identifying the date on which the Notice was received and requesting from the Owner the information and documentation (the "**Information**") the Surety requires to continue the Investigation and, if necessary, request access to personnel who are knowledgeable about the circumstances of the Notice and to the Contract work site(s) where the work is being performed. Upon receipt of the Surety's Acknowledgement, the Owner shall promptly, and in accordance with terms of the Contract, provide the Surety with the requested Information and access to personnel and the work site(s) within its possession or control.
- 3.3 The Surety shall within a reasonable time conduct the Investigation, but in any event no later than twenty (20) business days after receipt by the Surety of a Notice (or such longer period as may be agreed between the Surety and Owner), the Surety shall provide the Owner with its written response to the Notice, substantially in the form set out at Schedule C (the "**Surety's Position**"), advising either that:
- a) The Surety accepts liability under the Bond and proposes to satisfy its Obligation by performing one of the options set out in Section 6.1; or
  - b) The Surety does not accept liability, providing its specific reasons; or
  - c) The Surety is unable to determine whether or not one or more of the Conditions Precedent has been satisfied and, in the Surety's sole discretion, the Surety may propose a process for collaborating with the Owner in the advancement of the completion of the work so as to attempt to mitigate the Owner's cost to complete the Contract.
- 3.4 The Surety shall also, if requested by the Owner to do so, meet with the Owner to discuss the status of the Investigation within five days following receipt of the request. This meeting may take place via a face-to-face meeting, a telephone conference call or a meeting by any other form of electronic media as may be mutually agreed to by the Owner and Surety.

### **4. Necessary Interim Work**

- 4.1 Prior to and during the Investigation, if the Owner must take action which is necessary to:
- a) ensure public or worker safety,
  - b) preserve or protect the work under the Contract from deterioration or damage, or
  - c) comply with applicable law,

(the "**Necessary Interim Work**")

the Owner may, acting with due diligence and provided written notice is subsequently provided to the Surety within three (3) Business Days of the commencement of such Necessary Interim Work, undertake such

Necessary Interim Work provided that:

- i. Owner shall allow the Surety and/or its consultant(s) reasonable access to the Contract work site(s) during the course of the Necessary Interim Work for the purpose of monitoring the progress of the Necessary Interim Work;
  - ii. any such Necessary Interim Work shall be undertaken without prejudice to the rights of the Owner, the Contractor or the Surety under the Contract, this Bond or applicable law; and
  - iii. the reasonable costs incurred by the Owner in undertaking such Necessary Interim Work (to the extent they are not deducted in the calculation of the Balance of Contract Price in Section 9.1) shall be reimbursed by the Surety, subject to the Surety's liability being subsequently established and subject to such expenses being covered by this Bond. Any payments made by the Surety in respect of the Necessary Interim Work shall reduce the Bond Amount by the amount of any such payments.
- 4.2 Nothing in this section is intended to limit the ability of an Owner to take whatever steps are reasonably necessary in the public interest.
- 4.3 Subject to the foregoing provisions in Section 4.1, the Surety shall not raise the mere fact that the Necessary Interim Work proceeded as a defence to any claim by the Owner hereunder.

## **5. Post-Notice Conference**

- 5.1 Upon receipt of a Notice, the Surety shall propose a face-to-face meeting, telephone conference call or a meeting by any other form of electronic media (a "**Post-Notice Conference**") with the Owner at a mutually convenient time and place within five (5) business days (or such longer period as may be agreed between the Surety and Owner). The Contractor may participate in a Post-Notice Conference at the invitation of the Surety.
- 5.2 The purpose of the Post-Notice Conference shall be to determine what actions or work, if any, the Owner believes must be done while the Surety is conducting the Investigation in order to effectively mitigate the costs for which the Owner is seeking recovery under this Bond (the "**Mitigation Work**"). Mitigation Work may be performed after Necessary Interim Work and throughout the period of investigation by the Surety.
- 5.3 Provided the Owner provides reasonable evidence to the Surety that Mitigation Work is necessary during the Investigation and that the anticipated costs are reasonable, the Owner may proceed with the Mitigation Work subject to the following conditions:
- a) Owner shall pay the reasonable costs of the Mitigation Work;
  - b) Owner shall keep separate records of all amounts related to the Mitigation Work for which it intends to seek recovery under this Bond, including amounts to be set off against the Balance of Contract Price;
  - c) Owner shall allow the Surety and/or its consultant(s) reasonable access to the Contract work site(s) during the course of the Mitigation Work for the purpose of monitoring the progress of the Mitigation Work; and
  - d) the Mitigation Work shall be without prejudice to the rights or obligations of the Owner, the Contractor or the Surety under the Contract, this Bond or applicable law.
- 5.4 If the Surety objects to any part of the Mitigation Work, including without limitation the Owner's proposed Mitigation Work contractor(s), scope of work, cost or method of work, it shall immediately advise the Owner in writing of its objections and the reasons therefor. The Owner may still proceed with the Mitigation Work and the Surety's objections will be addressed through negotiation with the Owner or at the trial of any action brought pursuant to this Bond.
- 5.5 The reasonable costs incurred by the Owner in undertaking the Mitigation Work shall be reimbursed by the Surety, subject to the Surety's liability being subsequently established. Any payments made by the Surety in respect of the Mitigation Work shall form part of its Obligation under this Bond and shall reduce the Bond Amount by the amount of any such payments.
- 5.6 For greater clarity, any Necessary Interim Work being performed by the Owner pursuant to Section 4 may continue to be performed pending an agreement, if any, as to the Mitigation Work.
- 5.7 Subject to the foregoing provisions in this Section 5, the Surety shall not raise the mere fact that the Mitigation

Work proceeded as a defence to any claim by the Owner hereunder.

## **6. Surety's Options**

- 6.1 If the Surety has accepted liability pursuant to this Bond, the Surety shall promptly select and commence one of the following options:
- a) remedy the default; or
  - b) complete the Contract in accordance with its terms and conditions; or
  - c) obtain a bid or bids for submission to the Owner for completing the Contract in accordance with its terms and conditions and, upon determination by the Owner and the Surety of the lowest responsible bidder:
    - i. arrange for a contract between such bidder and the Owner; and
    - ii. make available as work progresses (even if there should be a default, or a succession of defaults, under the contract or contracts of completion, arranged under this paragraph) sufficient funds to complete the Contractor's obligations in accordance with the terms and condition of the Contract including any applicable value-added taxes for which the Surety may be liable, less the Balance of Contract Price; or
  - d) pay the Owner the lesser of: (1) the Bond Amount, or (2) without duplication, the Owner's Direct Expenses plus the Owner's proposed cost of completion of the Contract and any applicable value-added taxes for which the Surety may be liable, less the Balance of Contract Price.
- 6.2 The option selected by the Surety is referred to in this Bond and the Schedules as the "**Surety Option**".

## **7. Owner's Direct Expenses**

- 7.1 Where the Surety is liable under this Bond, then the Surety shall be liable for the following fees and expenses, without duplication (the "**Owner's Direct Expenses**"):
- a) reasonable professional fees incurred by the Owner to complete the Contract which are a direct result of the Contractor's default and which would not have been incurred but for the default of the Contractor;
  - b) reasonable external legal fees incurred by the Owner to complete the Contract, which are a direct result of the Contractor's default and which would not have been incurred but for the default of the Contractor, with the exception of legal fees incurred by the Owner in defending a claim or action by the Contractor, or incurred by the Owner in pursuing an action against the Contractor;
  - c) reasonable, miscellaneous and out-of-pocket expenses incurred by the Owner to complete the Contract which are a direct result of the default of the Contractor and which would not have been incurred but for the default of the Contractor;
  - d) direct costs incurred as a result of an extension of the duration of the supply of services or materials used or reasonably required for use in the performance of the Contract, which are a direct result of the default of the Contractor and which would not have been incurred but for the default of the Contractor;
  - e) reasonable costs of the Necessary Interim Work;
  - f) reasonable costs of the Mitigation Work; and
  - g) any additional fees and expenses agreed to by the Obligee, the Principal and the Surety.
- 7.2 For the purpose of Section 7.1(d), the "direct costs" incurred are the reasonable costs of performing the Contract during the extended period of time, including costs related to the additional supply of services or materials (including equipment rentals), insurance and surety bond premiums, and costs resulting from seasonal conditions, that, but for the extension, would not have been incurred.
- 7.3 Subject to any agreement to the contrary, between the Owner, the Principal and the Surety, the Surety shall not be liable under this Bond for:
- a) any liquidated damages under the Contract;
  - b) if no liquidated damages are specified in the Contract, any damages caused by delayed performance or non-performance of the Contractor, except as provided in Section 7.1(d); or

- c) any indirect or consequential damages, including but not limited to costs of financing, extended financing, hedging arrangements, loss of or deferral of profit, productivity or opportunity, or head office overhead costs.

7.4 If the Surety is liable under this Bond then, at the Owner's option, Owner's Direct Expenses may be deducted by the Owner from the Balance of the Contract Price as defined hereinafter or will be promptly reimbursed by the Surety subject to the other terms, conditions and limitations of this Bond and will reduce the Bond Amount.

## **8. Conditions Precedent**

- 8.1 The Surety shall have no liability or Obligations under this Bond unless all of the following conditions precedent (the "**Conditions Precedent**") have been satisfied:
- a) The Contractor is, and is declared by the Owner to be, in default under the Contract;
  - b) The Owner has given such notice to the Contractor of a default of the Contractor, as may be required under the terms of the Contract;
  - c) The Owner has performed the Owner's obligations under the Contract; and
  - d) The Owner has agreed to pay the Balance of Contract Price to the Surety or as directed by the Surety.

## **9. Balance of Contract Price**

- 9.1 The term "**Balance of Contract Price**" means the total amount payable by the Owner to the Contractor under the Contract, including any adjustments to the price in accordance with the terms and conditions of the Contract, or other amounts to which the Contractor is entitled, reduced by any amounts deducted by the Owner for the Owner's Direct Expenses under Section 7.4 and all valid and proper payments made to or on behalf of the Contractor under the Contract.
- 9.2 The Balance of Contract Price shall be used by the Owner to first mitigate against any potential loss to the Surety under this Bond and then under the Labour & Material Payment Bond, and the Owner shall assert all rights and remedies available to the Owner to the Balance of Contract Price and make payment of the Balance of Contract Price as directed by the Surety.

## **10. Limitations on the Surety's Liability**

- 10.1 Notwithstanding anything to the contrary contained in this Bond or in the Contract, the Surety shall not be liable for a greater sum than the Bond Amount under any circumstances.
- 10.2 The Surety's responsibility to the Owner under this Bond in respect of any Surety Option or Owner's Direct Expenses shall not be greater than that of the Contractor under the Contract.

## **11. Right of Action**

- 11.1 No right of action shall accrue on this Bond to or for the use of any person or corporation other than the Owner named herein, or the heirs, executors, administrators or successors of the Owner.

## **12. Commencement of Action**

- 12.1 It is a condition of this Bond that any suit or action must be commenced before the expiration of two (2) years from the earlier of: (a) the date of substantial performance of the Contract as defined under the *Construction Act* (the "**Act**"); or (b) the date on which a Notice in respect of the default that is the subject of such suit or action is received by the Surety under this Bond.
- 12.2 The Owner, the Contractor and the Surety agree that any suit or action is to be made to a court of competent jurisdiction in Ontario and agree to submit to the jurisdiction of such court notwithstanding any terms to the contrary in the Contract.

## **13. Common Law Rights**

- 13.1 The rights and obligations of the Owner, the Contractor, and the Surety under this Bond are in addition to their respective rights and obligations at common law and in equity.

## **14. Applicable Law**

- 14.1 This Bond is governed by the laws of the Province of Ontario.

## 15. Notices

- 15.1 All notices under this Bond shall be delivered by registered mail, facsimile, or electronic mail at the addresses set out below, subject to any change of address in accordance with this Section. Any notice given by facsimile or electronic mail shall be deemed to have been received on the next business day or, if later, on the date actually received if the person to whom the notice was given establishes that he or she did not, acting in good faith, receive the notice until that later date. Any notice given by registered mail shall be deemed to have been received five (5) days after the date on which it was mailed, exclusive of Saturdays and holidays or, if later, on the date actually received if the person to whom the notice was mailed establishes that he or she did not, acting in good faith, receive the notice until that later date. A change of address for the Surety is publicly available on the Financial Services Regulatory Authority of Ontario website. The address for the Owner or the Contractor may be changed by giving notice to the other parties setting out the new address in accordance with this Section.

### The Surety:

[Surety corporate name]  
[address]  
[fax]  
[email]

### The Owner:

[Owner proper name]  
[address]  
[fax]  
[email]

### The Contractor:

[Contractor corporate name]  
[address]  
[fax]  
[email]

## 16. Headings for Reference Only

- 16.1 The headings and references to them in this Bond are for convenience only, shall not constitute a part of this Bond, and shall not be taken into consideration in the interpretation of this Bond.

IN WITNESS WHEREOF, the Contractor and the Surety have Signed and Sealed this Bond this \_\_\_\_\_ day of \_\_\_\_\_ in the year \_\_\_\_\_.

[Contractor proper name]

By: \_\_\_\_\_

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

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

I have authority to bind the corporation.

Witnessed by :

Name of Witness: \_\_\_\_\_

Address of Witness: \_\_\_\_\_

[Surety corporate name]

By: \_\_\_\_\_

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

Attorney-in-fact

\* IF THERE ARE TWO OR MORE COMPANIES IN PARTNERSHIP OR JOINT VENTURE, JOINTLY AND SEVERALLY BOUND, INSERT THE NAME OF EACH PARTNER OR JOINT VENTURE PARTY, AND INSERT THE WORD "COLLECTIVELY" AFTER THE WORD "HEREINAFTER" IN THE FIRST LINE.

\*\* IF THERE ARE TWO OR MORE SURETY COMPANIES, JOINTLY AND SEVERALLY BOUND, INSERT THE "[Name of the surety company], a corporation created and existing under the laws of [Place of incorporation]," FOR EACH SURETY, FOLLOWED BY "each as a surety and each duly authorized to transact the business of Suretyship in the Province of Ontario and hereinafter collectively called the "Surety"".

\*\*\* INSERT THE CROWN, A MUNICIPALITY OR A BROADER PUBLIC SECTOR ORGANIZATION, AS APPLICABLE, OR SUCH OTHER PARTY DEEMED TO BE THE OWNER UNDER THE ACT, AND ENTERING INTO THE PUBLIC CONTRACT WITH THE CONTRACTOR.



**SCHEDULE A**  
Form of Notice

[date]

[Surety name]

[Surety address]

[Surety address]

[Surety's electronic/email address]

Attention:

Re: \_\_\_\_\_

Bond No: \_\_\_\_\_

Contractor: \_\_\_\_\_

Owner: \_\_\_\_\_

Contract: \_\_\_\_\_

Dear Sir/Madam,

We hereby notify you that the Contractor is in default of the captioned Contract. In general terms the details of the default are as follows:

[insert description of the Contractor Default]

We have given such notice of this default to the Contractor as is required under the Contract and enclose a copy for your records, and confirm that we have honoured our obligations under the Contract.

We call on you as Surety to honour your obligations under the Bond. We represent and warrant that we have in our possession the original, executed Performance Bond and herein enclose a copy.

Please provide us with potential dates and times to conduct the Post-Notice Conference under Section 5.1 of the Bond.

**OPTIONAL:** In the circumstances we plan to proceed with work and incur expenses necessary in the circumstances to ensure public safety or to preserve or protect the work under the Contract from deterioration or damage, referred to as the Necessary Interim Work under Section 4.1 of the Bond, and will provide you with information and access to discuss and observe this work. In the interim the following is a general description of the anticipated Necessary Interim Work:

**OPTIONAL:** To assist you in your Investigation we enclose with this Notice the documents and information indicated in Appendix A to this Notice. *[In addition to Appendix A, the Owner is encouraged to provide any information or material that may expedite the Investigation.]*

We look forward to receiving your acknowledgment of this Notice no later than four (4) business days of receipt and your request for any additional documentation or information you require to meet your obligations under the Bond.

Your truly,

[Full corporate title]

By: \_\_\_\_\_

[Name]

[Title]

[Phone]

[Email address]

CC: [Contractor]

## Appendix A to Form of Notice

The following checked documents and information are enclosed with this Notice:

- ☐ Copy of full, executed Contract (with letter of award), including approved changes and pending changes relevant to this Notice (along with a copy of the Change Order log)
- ☐ Copy of original schedule and latest approved schedule for the Contract including actual progress and the order to commence work
- ☐ Specifications and drawings, including tender and post tender addenda, if any, applicable to the Contractor's scope of work
- ☐ Copies of and summary reconciliation of all invoices received under the Contract
- ☐ Copies of and summary reconciliation of all payments made and holdback of any kind retained under the Contract
- ☐ Copy of the most recent approved or certified payment application including the applicable Schedule of Values and copies of all unpaid payment applications
- ☐ A detailed list of all outstanding work in the Contractor's scope of work (including any deficiencies identified to date)
- ☐ Any issued or pending backcharges from the Owner to the Contractor
- ☐ Copy of any notice or correspondence to and from the Contractor related to the Contract and relevant to this Notice
- ☐ Copy of any claim for lien, legal proceeding or other documents received on the Contract
- ☐ Copy of any correspondence from subcontractors, suppliers or others indicating claims for unpaid amounts related to the Contract
- ☐ Copy of the executed and delivered Performance Bond
- ☐ [\[Additional documents or information\]](#)

**SCHEDULE B**  
Surety's Acknowledgement of a Notice

[date]

[Name/corporate title of the Owner]

[Address]

[Address]

[E-mail address (if provided in the Notice of Claim)]

Attention:

Re: \_\_\_\_\_

Bond No: \_\_\_\_\_

Contractor: \_\_\_\_\_

Owner: \_\_\_\_\_

Contract: \_\_\_\_\_

Dear Sir/Madam,

On behalf of the Surety defined in the captioned Bond we acknowledge receipt on \_\_\_\_\_ of your Notice  
(date of receipt)

under the captioned Performance Bond.

Please advise as soon as possible which of the following proposed dates and times and logistics are convenient to conduct the Post-Notice Conference:

Proposed Date	Proposed Time	Meeting or conference/video conference logistics

To enable our Investigation of the Notice please provide us promptly with the information and/or documentation identified in Appendix A to this Acknowledgement (and as necessary with access for our staff or appointed representatives to attend the place where the Contract is being performed to inspect the condition and progress of the work), hereinafter the Information.

We will provide you with the Surety's Position to the Notice no later than twenty (20) business days of our receipt of the Notice based on the information, documentation and access you have provided.

We continue to reserve all of our rights pursuant to the Bond and at law.

Yours truly;

[Corporate name of the Surety]

By: \_\_\_\_\_

[Name]

[Title]

[Phone]

[Email address]

CC: [Contractor]

**Appendix A to Surety's Acknowledgement**  
Surety's Request for Information

Please identify and provide contact information for a person who is knowledgeable about the circumstances of the Notice and any Necessary Interim Work and Mitigation Work, and who can speak for the Owner.

Please identify and provide contact information for a person with whom arrangements can be made for access to the site where the work under the Contract is being performed.

Please provide copies of the following documentation in digital or hard copy format:

- ☐ Copy of full, executed Contract (with letter of award), including approved changes and pending changes relevant to this Notice (along with a copy of the Change Order log)
- ☐ Copy of original schedule and latest approved schedule for the Contract including actual progress and the order to commence work
- ☐ Specifications and drawings, including tender and post tender addenda, if any, applicable to the Contractor's scope of work
- ☐ Copies of and summary reconciliation of all invoices received under the Contract
- ☐ Copies of and summary reconciliation of all payments made and holdback of any kind retained under the Contract
- ☐ Copy of the most recent approved or certified payment application including the applicable Schedule of Values and copies of all unpaid payment applications
- ☐ A detailed list of all outstanding work in the Contractor's scope of work (including any deficiencies identified to date)
- ☐ Any issued or pending backcharges from the Owner to the Contractor
- ☐ Copy of any notice or correspondence to and from the Contractor related to the Contract and relevant to this Notice
- ☐ Copy of any Notice of Non-payment issued under the Act
- ☐ Copy of any Notice of Adjudication issued under the Act
- ☐ Copy of any claim for lien, legal proceeding or other documents received on the Contract
- ☐ Copy of any correspondence from subcontractors, suppliers or others indicating claims for unpaid amounts related to the Contract
- ☐ Copy of the executed and delivered Performance Bond
- ☐ [\[Additional documents or information\]](#)

**SCHEDULE C**  
Surety's Position

[date]

[Name/corporate title of the Owner]

[Address]

[Address]

[E-mail address (if provided in the Notice of Claim)]

Attention:

Re: \_\_\_\_\_

Bond No: \_\_\_\_\_

Contractor: \_\_\_\_\_

Owner: \_\_\_\_\_

Contract: \_\_\_\_\_

Dear Sir/Madam,

Based on the Information you have provided and given the current status of our Investigation, we can advise that [use only one of these Options]:

**OPTION A**

The Surety accepts liability under the Bond. To satisfy our Obligation we propose, under Section 6.1 of the Bond, to:

*[Select 1 and delete the others]*

- a) Promptly remedy the Contractor Default. *[Describe proposal and timelines.]*  
**or**
- b) Complete the Contract in accordance with its terms but only on the condition that the Owner undertakes to pay or to make available to the Surety the Balance of the Contract Price. *[Describe proposal and timelines.]*  
**or**
- c) Obtain a bid or bids for submission to the Owner for completing the Contract in accordance with its terms and conditions and, upon determination by the Owner and the Surety of the lowest responsible bidder:
  - i. arrange for a contract between such bidder and the Owner; and
  - ii. make available as work progresses (even if there should be a default, or a succession of defaults, under the contract or contracts of completion, arranged under this paragraph) sufficient funds to complete the Contractor's obligations in accordance with the terms and conditions of the Contract including any applicable value-added taxes for which the Surety may be liable, less the Balance of Contract Price.*[Describe proposal and timelines.]*  
**or**
- d) pay the Owner the lesser of : (1) the Bond Amount, or (2) without duplication, the Owner's Direct Expenses plus the Owner's proposed cost of completion of the Contract and any applicable value-added taxes for which the Surety may be liable; less the Balance of Contract Price. *[Describe proposal and timelines.]*

**OPTION B**

The Surety disputes the Notice. The reasons are as follows:

## OPTION C

Based on the Information you have provided and the time available for our Investigation

*[if applicable]* and taking into account genuine disputed issues as between the Owner and the Contractor that have not been resolved according to the terms of the Contract as outlined generally below,

the Surety is unable to determine whether or not one or more of the Conditions Precedent has been satisfied and, therefore, is not able to accept liability under the Bond.

In particular we have been unable to determine that

*[delete those that do not apply]*

- a) the Contractor is, in fact, in default of its obligations under the Contract. *[Provide further explanation as appropriate.]*  
*and/or*
- b) the Owner has performed its obligations under the Contract. *[Provide further explanation as appropriate.]*  
*and/or*
- c) the Owner has given the notice to the Contractor of a Contractor Default as required under the terms of the Contract. *[Provide further explanation as appropriate.]*  
*and/or*
- d) the Owner has agreed to apply the Balance of Contract Price as necessary to enable the Surety to exercise the Surety Option under the Bond. *[Provide further explanation as appropriate.]*

With your agreement and assistance we are willing to extend our Investigation in an effort to resolve outstanding issues. Should this extended Investigation allow us to provide you with an alternative Surety's Position we will do so promptly.

*[If applicable]* Under a full reservation of all of our rights under the Bond and the applicable law, and without prejudice to the rights and obligations of the Owner, the Contractor or the Surety under the Bond we propose to proceed as follows:

We continue to reserve all of our rights pursuant to the Bond and at law.

If you have any questions or concerns, please do not hesitate to contact us.

Yours truly;

**[Corporate name of the Surety]**

By:

**[Name]**  
**[Title]**  
**[Phone]**  
**[Email address]**

CC: **[Contractor]**

**1.1 GENERAL CONDITIONS**

- .1 The Form of Agreement and the General Conditions of the Contract are contained in the Canadian Construction Documents Committee CCDC 2-2020: Stipulated Price Contract, as amended by supplementary conditions, as published in Section 00 80 00 - Supplementary Conditions, and Special Provisions, as published in the Request for Tender document.
- .2 A copy of the CCDC 2-2020 Stipulated Price Contract may be obtained at the Contractor's expense from any Construction Association or directly from the Canadian Construction Documents Committee Website, located at:
  - .1 [www.ccdc.org](http://www.ccdc.org)
- .3 Refer to CCDC 41 for related insurance requirements.

**END OF SECTION**

## **PREAMBLE**

The Standard Construction Document for CCDC 2 Stipulated Price Contract, 2020 English version, consisting of the Agreement Between Owner and Contractor, Definitions, and General Conditions of the Stipulated Price Contract, Parts 1 to 14 inclusive, governing same is hereby made part of these Contract Documents, with the following amendments, additions and modifications. Where these amendments, additions, and modifications specifically reference a change to the Agreement, Definitions, or General Conditions, these amendments, additions and modifications shall govern. Where a General Condition or paragraph of the General Conditions of the Stipulated Price Contract is deleted by these Supplementary Conditions, the numbering of the remaining General Conditions or paragraphs shall remain unchanged, and the numbering of the deleted item will be retained, unused.

## **AMENDMENTS TO AGREEMENT**

### **1.1 ARTICLE A-6 – RECEIPT AND ADDRESSES FOR NOTICES IN WRITING**

- .1 Delete paragraph 6.5 of Article A-6 in its entirety and replace it with the following:  
“6.5 Contact information for a party may be changed by Notice in Writing to the other party setting out the new contact information in accordance with this Article.”

## **AMENDMENTS TO DEFINITIONS**

- .2 Add the following definition: Payment Certifier  
“The Payment Certifier” is the person or entity identified as such by Owner, responsible for the issuance of certificates for payment. Unless decided otherwise by the Owner, the Consultant may act as the Payment Certifier.”
- .3 Add the following definition: Proper Invoice  
“Proper Invoice include, in addition to what is stipulated under the Ontario Construction Act (referenced elsewhere in this document as, ‘Payment Legislation’), and the requirements specified under GC 5.2, the following:
- The information required by section 6.1 of the Construction Act for “proper invoices”,
  - The acceptance by the Payment Certifier of the amounts claimed according to approved Schedule of Values submitted as a draft invoice minimum 5 days earlier,
  - Test certificates by third-parties demonstrating the compliance of parts of the Work, for which request for payment is being submitted, with the contract conditions,
  - Verification, acceptable to the Owner, that deficiencies identified related to the parts of the Work for which the request for payment is being submitted, have been rectified,
  - WSIB Insurance Certificate,
  - Statutory Declaration regarding payment of all subcontractors and suppliers,
  - Project Schedule, updated to date,
  - such other information that is prescribed by the Contract Documents or is reasonably requested by the Owner or Payment Certifier.”
- Proper Invoice to have the same meaning as Application for Payment referenced in GC 5.3 Payment.
- .4 Add the following definition: Submittals



"Submittals are documents or items required by the Contract Documents to be provided by the Contractor such as:

- Shop Drawings, samples, models, mock ups to indicate details or characteristics, before the portion of the Work that they represent can be incorporated into the Work, and
- As-built drawings and manuals to provide instructions to the operation and maintenance of the Work."

## **SUPPLEMENTARY CONDITIONS**

### **PART 1 GENERAL PROVISIONS**

#### **.5 GC 1.1 CONTRACT DOCUMENTS**

- .1 Delete paragraphs 1.1.3 and 1.1.4 in their entirety and replace them with the following:

"1.1.3 The Contractor shall review the Contract Documents for the purpose of facilitating and co-ordination and execution of the Work by the Contractor. The Contractor shall report promptly to the Consultant any ambiguities, design issues or other matters requiring clarification made known to the Contractor or that the Contractor may discover from such a review. Such review by the Contractor shall comply with the standard of care described in paragraph 3.9.1 of the Contract.

1.1.4 Except for its obligation to review the Contract Documents and report the result pursuant to paragraph 1.1.3, The *Contractor* is not responsible for errors, omissions or inconsistencies in the *Contract Documents*. If there are perceived errors, omissions or inconsistencies discovered by or made known to the *Contractor*, the *Contractor* shall promptly report to the *Consultant* and shall not proceed with the work affected until the *Contractor* has received corrected or additional information from the *Consultant*. The impacts of any ambiguities, design issues or other matters requiring clarification in the Contract Documents, including to the Contract Price and Contract Time, shall be addressed by the parties in accordance with Part 6 – CHANGES."

- .2 Add the following to the end of subparagraph 1.1.6.2:

"Except to the extent the Consultant is indemnified as a third party beneficiary as provided in subparagraphs 9.2.7.4 and 9.5.3.4 and in paragraph 13.1.3."

### **PART 2 ADMINISTRATION OF THE CONTRACT**

#### **.1 GC 2.2 ROLE OF THE CONSULTANT**

- .1 In paragraph 2.2.3 add the following to the end:

"Without limiting the foregoing, the Consultant may appoint one or more authorized representatives in writing who may fulfill the obligations of the Consultant under this Contract."

- .2 In paragraph 2.2.8 add new sentence "The interpretations and findings of the Consultant will take precedence over any interpretations or findings by Contractor and Subcontractors." to the end of the first sentence; and

.1 add the following to the end of paragraph 2.2.8:

"The Owner and the Contractor shall waive any claims against the Consultant arising out of its making of any interpretations, written statements or findings in accordance with paragraphs 2.2.6, 2.2.7, 2.2.8, and 7.1.2, but only to the extent that any such interpretations, written statements, and findings are made by the Consultant in an unbiased manner, and in accordance with the Consultant's professional standard of care at law."

- .3 In paragraph 2.2.13 add the words "which are provided" before the words "by the Contractor".

**.2 GC 2.4 DEFECTIVE WORK**

- .1 In paragraph 2.4.1:

- .1 Add after the words "shall promptly correct" the phrase "in a manner acceptable to the Owner and the Consultant"; and
- .2 Add after the words "Contract Documents" the phrase "or work that the Contractor discovers to be defective, whether or not the defective work had been identified by the Consultant, and".

- .2 Add new paragraph 2.4.4 as follows:

"2.4.4 The Contractor shall prioritize the correction of any defective work which, in the sole discretion of the Owner, adversely affects the day-to-day operation of the Owner."

**.3 GC 2.5 ROLE OF THE PAYMENT CERTIFIER**

**ADD NEW GC 2.5 ROLE OF THE PAYMENT CERTIFIER**

- .1 Add new paragraphs to GC 2.5 as follows:

"2.5.1 The duties, responsibilities and limitations of authority of the Payment Certifier as set forth in the Contract Documents shall be modified or extended only with written consent of Owner and Contractor."

"2.5.2 Neither the authority of the Payment Certifier to act nor any decision either to exercise or not exercise such authority shall give rise to any duty or responsibility of the Payment Certifier to the Contractor, Subcontractors, Suppliers, or their agents, employees or other persons performing any of the Work."

"2.5.3 Based on the Payment Certifier's observations and evaluation of the Contractor's application for payment (submitted according with GC5.2 and GC5.3), the Payment Certifier will determine the amounts owing to the Contractor under the Contract and will issue a certificate for payment as provided in Article A-5 of the Agreement – PAYMENT, GC 5.3 PAYMENT, and GC 5.5 FINAL PAYMENT."

"2.5.3 The Owner may provide to the Subcontractors or Suppliers, through the Payment Certifier, information as to the percentage of the Work that has been certified for payment."

**PART 3 EXECUTION OF THE WORK**

**.1 GC 3.1 CONTROL OF THE WORK**

- .1 Add new paragraph 3.1.3 as follows:
- .2 “3.1.3 Prior to commencing individual procurement, fabrication and construction activities, the Contractor shall verify, at the Place of the Work, all relevant measurements and levels necessary for proper and complete fabrication, assembly and installation of the Work and shall further carefully compare such field measurements and conditions with the requirements of the Contract Documents. Where dimensions are not included or contradictions exist, or exact locations are not apparent, the Contractor shall immediately notify the Consultant in writing and obtain written instructions from the Consultant before proceeding with any part of the affected work.”

**.2 GC 3.2 CONSTRUCTION BY OWNER AND OTHER CONTRACTORS**

- .1 Add new paragraph 3.2.7 as follows:  
“3.2.7 At the commencement of the Work, the Contractor shall prepare for the review and acceptance of the Owner and the Consultant, a schedule indicating the times, within the construction schedule referred to in GC 3.4, that items that are specified to be Owner purchased and Contractor installed or hooked up are required at the site to avoid delaying the progress of the Work.”

**.3 GC 3.7 LABOUR AND PRODUCTS**

- .1 Add the following to the end of paragraph 3.7.1:  
“The Contractor represents that it has sufficient skilled employees to replace, subject to the Owner’s approval, acting reasonably, its designated supervisor and project manager in the event of death, incapacity, removal or resignation.”
- .2 Add new paragraph 3.7.4 as follows:  
“The Contractor represents that it will provide project staffing consistent with the personnel proposed at time of tender for the positions of Contractor’s Project Manager, Site Super-intendant, and Project Coordinator, subject to approval by the Owner, and that it will not change these personnel once approved by the Owner unless agreed to by the Owner. Any newly proposed personnel to have similar or higher expertise and experience in the field, than those personnel being replaced, subject to Owner’s approval.
- .3 Add new paragraphs 3.7.4 and 3.7.5 as follows:  
“3.7.4 The Owner shall provide the Contractor in a timely manner with all relevant information (including storage, protection, and installation requirements) regarding Products to be supplied by the Owner or other contractors and, prior to delivery of any such Products to the Place of the Work.  
3.7.5 Once the Contractor has accepted delivery of Products, the Contractor shall be responsible for the safe storage and protection of Products as required to avoid dangerous conditions or contamination to the Products or other persons or property. Products shall be stored in locations and at the Place of the Work to the satisfaction of the Owner and the Consultant.

**.4 GC 3.8 SHOP DRAWINGS**

- .1 Add the words “AND OTHER SUBMITTALS” to the title of GC 3.8 after the words “SHOP DRAWINGS”.

- .2 Add the words "and Submittals" after the words "Shop Drawings" in paragraphs 3.8.1, 3.8.2, 3.8.3, 3.8.3.2, 3.8.5, 3.8.6, and 3.8.7.
- .3 Delete paragraph 3.8.2 in its entirety and replace it with new paragraph 3.8.2 as follows:  
  
"3.8.2 Prior to the first application for payment, the Contractor and the Consultant shall jointly prepare a schedule of the dates for submission and return of Shop Drawings and Submittals in an orderly sequence."
- .4 Add sub-paragraph 3.8.3.3 to paragraph 3.8.3, as follows:  
  
".3 the Contractor shall make a decent effort to complete a thorough review of the Shop Drawings & Submittals prior to forwarding them to the Consultant. This review shall include, in addition to what is describe in items 3.8.3.1 and 2 above, the extent and relevance of submittals to the Work, its thoroughness relative to the requirements under the Contract Documents and the required work. At no time should the Contractor submit Shop Drawings or Submittals that are incomplete, irrelevant or not fully coordinated with the Work and the Contract Documents."
- .5 Add a new paragraph 3.8.7, as follows:  
  
The Contractor shall only use the drawings and information provided n the Contract Documents as permitted by the Consultant in writing and make its subcontractors to do the same. For added clarity, at no time shall the Contractor or its subcontractors or suppliers copy or re-use all or part of the drawings or Contract Documents for the purpose of preparation of shop drawings or submittals unless as expressly permitted by the Consultant in writing.

#### **.5 GC 3.9 PERFORMANCE BY CONTRACTOR**

- .1 Add new General Condition GC 3.9 as follows:

##### **"GC 3.9 PERFORMANCE BY CONTRACTOR**

- 3.9.1 In performing its services and obligations under the Contract, the Contractor shall exercise a standard of care, skill and diligence that would normally be provided by an experienced and prudent contractor supplying similar services for similar projects. The Contractor acknowledges and agrees that throughout the Contract, the Contractor's obligations, duties and responsibilities shall be interpreted in accordance with this standard. The Contractor shall exercise the same standard of due care and diligence in respect of any Products, personnel, or procedures which it may recommend to the Owner."

#### **PART 4 ALLOWANCES**

##### **.1 GC 4.1 CASH ALLOWANCES**

- .1 Delete paragraph 4.1.7 in its entirety and replace it with the following:  
  
"4.1.7 At the commencement of the Work, the Contractor shall prepare for the review and acceptance of the Owner and the Consultant a schedule indicating the times within the construction schedule referred to in GC 3.4 that items called for under cash allowances are required to be delivered to the Place of the Work to avoid delaying the progress of the Work."
- .2 Add new paragraphs to GC 4.1 as follows:

“4.1.8 The Owner reserves the right to call, or to have the Contractor call, for competitive bids for portions of the Work to be paid for from cash allowances.

4.1.9 Where costs under a cash allowance exceed the amount of the allowance, unexpended amounts from other cash allowances shall be reallocated at the Owner's or Consultant's direction to cover the shortfall.

4.1.10 The net amount of any unexpended cash allowances, after providing for any reallocations as per paragraph 4.1.8, shall be deducted from the Contract Price by a Change Order.”

## **PART 5 PAYMENT**

### **.1 GC 5.2 APPLICATIONS FOR PAYMENT**

.1 Add new paragraph to GC5.2 as follows:

“5.2.9 The Contractor shall submit a draft invoice at least 5 days prior to the submission of each application for progress payment described in paragraphs 5.2.1 to 5.2.8, for review and approval by the Consultant. The” Proper Invoice” will only be submitted following the approval of the draft invoice by the Consultant, according with paragraph 3 of the Amendments to Definitions above.

### **.2 GC 5.4 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK**

.1 Delete all paragraphs of GC 5.4 in their entirety and replace them with the following paragraphs:

“5.4.1 Prior to submitting its application for Substantial Performance of the Work, the Contractor shall:

.1 obtain and provide to the Owner the municipal occupancy permit for the Work;

.2 ensure that all systems and equipment are started up, tested and commissioned except for final balancing;

.3 verify, and cause testing agencies to verify, that all life safety systems comply with the requirements of the Contract Documents; and

.4 ensure local building officials and fire authority have inspected and confirmed that life safety systems are acceptable.

.5 Submit Testing and Balancing Reports and obtain approval of the Consultant for the same.

.6 Any other materials or documentation required to be submitted under the Contract, together with written proof acceptable to the Owner and Consultant that the Work has been substantially performed in accordance with the requirements of municipal, governmental, and utility authorities having jurisdiction in the Place of the Work.

- 5.4.2 When the Contractor considers that the Work is substantially performed per 5.4.1, or if permitted by the lien legislation applicable to the Place of the Work a designated portion thereof which the Owner agrees to accept separately is substantially performed, the Contractor shall, within five (5) Working Days, deliver to the Consultant and to the Owner a comprehensive list of items to be completed or corrected, together with a written application for a review by the Consultant to establish Substantial Performance of the Work or substantial performance of the designated portion of the Work. Failure to include an item on the list does not alter the responsibility of the Contractor to complete the Contract.
- 5.4.3 The Consultant will review the Work to certify or verify the validity of the application and shall promptly, and in any event, no later than 10 calendar days after receipt of the Contractor's application:
- .1 advise the Contractor in writing that the Work or the designated portion of the Work is not substantially performed and give reasons why, or
  - .2 state the date of Substantial Performance of the Work or a designated portion of the Work in a certificate and issue a copy of that certificate to each of the Owner and the Contractor.
- 5.4.4 Subject to the requirements of any Payment Legislation, all holdback amounts prescribed by the applicable lien legislation for the Place of the Work shall become due and payable to the Contractor no later than 10 Working Days following the expiration of the holdback period stipulated in the lien legislation applicable to the Place of the Work, as certified or verified by the Payment Certifier when permitted by any Payment Legislation.
- 5.4.5 The Contractor shall submit an application for release of the lien holdback amount in accordance with the lien legislation applicable to the Place of the Work. Except to the extent required by any Payment Legislation, such application for release of the holdback shall not constitute an application for payment that is subject to Proper Invoice requirements."

**.3 GC 5.5 FINAL PAYMENT**

- .1 Add to the end of paragraph 5.5.1 the following sentences:
- "The application for final payment shall meet the requirements of a Proper Invoice and requirements under GC 5.2 APPLICATIONS FOR PAYMENT. Subject to any Payment Legislation, when the Consultant finds the Contractor's application for final payment to be not valid, the Contractor shall revise and resubmit the application when the Contractor has addressed the reasons given by the Consultant."
- .2 Add new paragraph to GC 5.5 as follows:
- "5.5.5 Prior to its application for Final Payment, the Contractor shall obtain and provide to the Owner all of the following (which are collectively referred to as the **"Closeout Documents"**):
- .1 guarantees;
  - .2 warranties;

- .3 certificates;
- .4 testing and balancing reports;
- .5 distribution system diagrams;
- .6 spare parts and attic stock materials identified in the Contract Documents;
- .7 operation and maintenance manuals and instructions;
- .8 samples;
- .9 as-built record drawings and as-built drawings in CAD format (in accordance with GC 14.2 – AS-BUILT DRAWINGS and any other applicable requirements in the Contract Documents;
- .10 existing reports required by, and any correspondence from, authorities having jurisdiction in the Place of the Work;
- .11 attendance sheets and confirmation that all training sessions required by the Contract Documents have been completed;
- .12 approved Shop Drawings and samples binders, and
- .13 any other materials or documentation required to be submitted under the Contract, together with written proof acceptable to the Owner that the Work has been substantially performed in accordance with the requirements of municipal, governmental, and utility authorities having jurisdiction in the Place of the Work.

The Closeout Documents shall, when provided by the Contractor, not be in draft form but shall rather be in a final form that has been reviewed and verified by the Consultant.

**.4 GC 5.8 – CONSTRUCTION LIENS**

- .1 .Add a new GC 5.8 as follows:**

**“GC 5.8 CONSTRUCTION LIENS**

5.8.1 Notwithstanding anything else in PART 5 - PAYMENT, in the event:

- .1 a claim for lien is registered against the Project or the Place of the
- .2 a claim for lien is given to the Owner, or
- .3 the Owner or any of its agents or employees receives a written notice of a lien, arising from the performance of the Work, the Owner shall be entitled to withhold any payment otherwise due to the Contractor until such time as such claims have been dealt with as provided below.

5.8.2 If a claim for lien arising from the performance of the Work is registered against the Project or the Place of the Work or given to the Owner, the Contractor shall, at its expense, vacate or discharge the lien within 10 calendar days of learning of the claim for lien's existence. If the lien is merely vacated, the Contractor shall, if requested, undertake the Owner's defense of any subsequent action commenced in respect of the lien at the Contractor's expense.

5.8.3 If a written notice of a lien arising from the performance of the Work is given to the Owner, the Contractor shall, at its expense, vacate or arrange for the withdrawal of the written notice of a lien within 10 calendar days of learning of the notice of lien's existence.

5.8.4 If the Contractor fails or refuses to vacate or discharge a claim for lien or fails or refuses to vacate or arrange for the withdrawal of a written notice of a lien within the time prescribed in paragraphs 5.8.2, and 5.8.3 (as applicable), the Owner shall, at its option, be entitled to take all steps necessary to vacate or discharge the lien or vacate or arrange for the withdrawal of the written notice of a lien (as applicable) and all costs incurred by the Owner in doing so (including legal fees on a full indemnity basis and any payment which may ultimately be made out of or pursuant to security posted to vacate the lien or written notice of a lien) shall be for the account of the Contractor, and the Owner may deduct such amounts from the amounts otherwise due or owing to the Contractor.

5.8.5 Without limiting any of the foregoing, the Contractor shall satisfy all judgments and pay all costs resulting from any construction liens arising from the performance of the Work or any actions brought in connection with such liens (or in connection with any other claim or lawsuit brought against the Owner by any person that provided work, services or materials that constituted part of the Work, and the Contractor shall indemnify the Owner for any and all costs (including legal fees on a full indemnity basis) that the Owner may incur in connection with such claims or actions.

5.8.6 This GC 5.8 shall not apply to the extent the claim for lien or written notice of a lien is a result of the Owner's failure to pay amounts properly due and owing to the Contractor in breach of the terms of this Contract. This GC 5.18 shall also not apply to liens claimed by the Contractor itself."

**.5 GC 5.9 – WITHHOLDING OF PAYMENT**

.1 Add a new GC 5.9 as follows:

**"GC 5.9 WITHHOLDING OF PAYMENT**

5.9.1 Upon notice to the Consultant, the Owner may withhold or retain all or any portion of any payment due to the Consultant under this Contract to ensure the performance of the Work or to protect the Owner's rights in respect of the events set out in this paragraph 5.8.1. The Owner may make such withholding or retention upon the occurrence and continuance of any of the following events:

- .1 the Design-Builder is in default of any of its obligations under this Contract;
- .2 all or any part of such payment is attributable to Work which is defective or not performed in accordance with the Contract Documents;
- .3 the Contractor has improperly failed to make prompt payments to its Subcontractors, Suppliers in respect of the Work for which the Owner has made payment to the Contractor;
- .4 liquidated damages or other amounts are payable by the Contractor to the Owner under the terms of this Contract; or
- .5 any lien has been registered against the Place of the Work, the Project, the Work or any portion of it, or against any Products, or a written notice of lien or a claim for lien has been given to the Owner, and such lien or written notice of lien has not been vacated, discharged or withdrawn (as applicable) in accordance with GC 5.8 – CONSTRUCTION LIENS."

**.6 GC 5.10 DEFICIENCY HOLDBACK**

.1 Add a new GC 5.10 as follows:

**"GC 5.10 DEFICIENCY HOLDBACK**



5.10.1 The Owner will retain and withhold from each progress payment to the Design-Builder 2% of such progress payment (the "**Deficiency Holdback**"). The Owner may deduct from the Deficiency Holdback any amounts owing by the Contractor to the Owner under this Contract whether the amounts relate to outstanding or deficient Work or any other claims the Owner may have including outstanding claims under GC 13.1 – INDEMNIFICATION. The balance of the Deficiency Holdback, if any, shall be eligible for release to the Contractor upon correction of defective work found during Consultant's review for certification of Substantial Performance.

**.7 GC 5.11 MAINTENANCE HOLDBACK**

.1 Add a new GC 5.10 as follows:

**"GC 5.11 MAINTENANCE HOLDBACK**

5.11.1 The Owner will retain and withhold from each progress payment to the Design-Builder 3% of such progress payment (the "**Maintenance Holdback**"). The Owner may deduct from the Maintenance Holdback any amounts owing by the Contractor to the Owner under this Contract whether the amounts relate to outstanding or deficient Work or any other claims the Owner may have including outstanding claims under GC 12.2 – INDEMNIFICATION. The balance of the Maintenance Holdback, if any, shall be eligible for release to the Contractor upon the expiration of the warranty period described in GC 12.3 – WARRANTY and only after all deficiencies and other warranty issues have been resolved in accordance with the Contract Documents."

**PART 6 CHANGES IN THE WORK**

**.1 GC 6.3 CHANGE DIRECTIVE**

- .1 Delete the word "and" from the end of subparagraph 6.3.7.18.
- .2 Delete the period from the end of subparagraph 6.3.7.19 and replace it with "and".
- .3 Add new subparagraph 6.3.7.20 as follows:  
".20 safety measures and requirements."

**.2 GC 6.4 CONCEALED OR UNKNOWN CONDITIONS**

- .1 Add new paragraph 6.4.5:  
"6.4.5 The Contractor confirms that, prior to bidding the Project, it carefully reviewed the Place of the Work and applied to that review the degree of care and skill described in paragraph 3.9.1, given the amount of time provided between the issue of the bid documents and the actual closing of bids, the degree of access provided to the Contractor prior to submission of bid, and the sufficiency and completeness of the information provided by the Owner. The Contractor is not entitled to compensation or to an extension of the Contract Time for conditions which could reasonably have been ascertained by the Contractor by such review undertaken prior to the submission of the bid."

**.3 GC 6.5 – DELAYS**

- .1 Amend paragraph 6.5.1 by deleting the period at the end of the paragraph and substituting the following: " , but excluding any consequential, indirect or special damages, loss of profit, loss of revenue, loss of opportunity or loss of productivity resulting from such delay."

- .2 Amend paragraph 6.5.2 by deleting the period at the end of the paragraph and substituting the following: “, but excluding any consequential, indirect or special damages, loss of profit, loss of revenue, loss of opportunity or loss of productivity resulting from such delay.
- .3 Amend paragraph 6.5.3 by adding the following to the end of the paragraph: “For clarity, any delays caused by the Contractor, Subcontractors or Suppliers, or those for whom any of them are directly or indirectly responsible, or any delays associated with supply chain disruptions, price escalation or market fluctuations, taxes, or material shortages or unavailability, shall not entitle the Contractor to an extension to the Contract Time.”

**.1 GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE**

- .1 Add the words “as noted in paragraph 6.6.3” after the words “of the claim” in paragraph 6.6.5 and add the words “and the Consultant”, at the end of paragraph 6.6.5.

**PART 7 DEFAULT NOTICE**

**.1 GC 7.1 OWNER’S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR’S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT**

- .1 Add Paragraph 7.1.7 as follows: “When a performance and/or materials bond has been obtained and submitted to Owner by Contractor, the provisions of paragraph 7.1.5 shall be exercised in accordance with the conditions of such performance and/or materials bond unless Owner chooses to forfeit its rights under said bond.”

**PART 8 DISPUTE RESOLUTION**

**.1 GC 8.2 ADJUDICATION**

- .1 Delete the word “prescribed” from paragraph 8.2.1 and substitute the words “provided for”.

**.2 GC 8.3 NEGOTIATION, MEDIATION AND ARBITRATION**

- .1 Add the following new paragraphs 8.3.9 to 8.3.13:
  - “8.3.9 Within five days of receipt of the notice of arbitration by the responding party under paragraph 8.3.6, the Owner and the Contractor shall give the Consultant a written notice containing:
    - .1 a copy of the notice of arbitration;
    - .2 a copy of supplementary conditions 8.3.9 to 8.3.14 of this Contract, and;
    - .3 any claims or issues which the Contractor or the Owner, as the case may be, wishes to raise in relation to the Consultant arising out of the issues in dispute in the arbitration.
  - 8.3.10 The Owner and the Contractor agree that the Consultant may elect, within ten days of receipt of the notice under paragraph 8.3.9, to become a full party to the arbitration under paragraph 8.3.6 if the Consultant:
    - .1 has a vested or contingent financial interest in the outcome of the arbitration;

- .2 gives the notice of election to the Owner and the Contractor before the arbitrator is appointed;
  - .3 agrees to be a party to the arbitration within the meaning of the rules referred to in paragraph 8.3.6, and,
  - .4 agrees to be bound by the arbitral award made in the arbitration.
- 8.3.11 Without limiting and subject to the Owner and Contractor's rights under paragraph 8.3.12 to challenge whether the Consultant has satisfied the requirements of paragraph 8.3.10, if an election is made under paragraph 8.3.10:
- .1 the Owner or Contractor may request particulars and evidence of the Consultant's vested or contingent financial interest in the outcome of the arbitration;
  - .2 the Consultant shall participate in the appointment of the arbitrator; and,
  - .3 notwithstanding the rules referred to in paragraph 8.3.6, the time period for reaching agreement on the appointment of the arbitrator shall begin to run from the date the respondent receives a copy of the notice of arbitration.
- 8.3.12 The arbitrator in the arbitration in which the Consultant has elected under paragraph 8.3.10 to become a full party may:
- .1 on application of the Owner or the Contractor, determine whether the Consultant has satisfied the requirements of paragraph 8.3.10, and;
  - .2 make any procedural order considered necessary to facilitate the addition of the Consultant as a party to the arbitration.
- 8.3.13 The provisions of paragraph 8.3.9 shall apply (with all appropriate changes being made) to written notice to be given by the Consultant to any sub-consultant."

## **PART 9 PROTECTION OF PERSONS AND PROPERTY**

### **.1 GC 9.1 PROTECTION OF WORK AND PROPERTY**

- .1 Delete subparagraph 9.1.1.1 in its entirety and replace it with the following:
  - "1 errors or omissions in the Contract Documents which the Contractor could not have discovered applying the standard of care described in paragraph 3.9.1;"
- .2 Delete paragraph 9.1.2 in its entirety and replace it with the following:
  - "9.1.2 Before commencing any Work, the Contractor shall determine the locations of all underground utilities and structures indicated in the Contract Documents, or that are discoverable by applying to an inspection of the Place of the Work the degree of care and skill described in paragraph 3.9.1."

**.2 GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES**

- .1 Add the following words to paragraph 9.2.6 after the word "responsible":  
"or whether any toxic or hazardous substances or materials already at the Place of the Work (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the Contractor or anyone for whom the Contractor is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damage to the property of the Owner or others,"
- .2 Add the words "and the Consultant" after the word "Contractor" in subparagraph 9.2.7.4.
- .3 Add the following words to paragraph 9.2.8 after the word "responsible":  
"or that any toxic or hazardous substances or materials already at the Place of the Work (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the Contractor or anyone for whom the Contractor is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damage to the property of the Owner or others,"

**.3 GC 9.4 CONSTRUCTION SAFETY**

- .1 Add the word "solely" after the word "Contractor" in paragraph 9.4.1.

**.4 GC 9.5 MOULD**

- .1 Add the words "and the Consultant" after the word "Contractor" in subparagraph 9.5.3.4.

**PART 10 GOVERNING REGULATIONS**

**.1 GC 10.1 TAXES AND DUTIES**

- .1 .1 Add a new paragraph 10.1.3 as follows:  
"10.1.3 Where the Owner is entitled to any available exemptions for rebates of sales taxes or customs duty or both of them, the Contractor shall supply to the Owner full particulars of sales tax, value added / harmonized taxes or customs duty paid, or other, in order to facilitate the application by the Owner for such refund. The Owner will retain such funds for its own use."

**.2 GC 10.2 LAWS, NOTICES, PERMITS, AND FEES**

- .1 Delete from the first line of paragraph 10.2.5 the word, "The" and substitute the words "Subject to paragraph 3.9.1, the".

**PART 11 INSURANCE**

**.1 GC 11.1 INSURANCE**

- .1 Delete Subparagraph 11.1.1.3 in its entirety.

**PART 12 OWNER TAKEOVER**

**.1 GC 12.1 READY-FOR-TAKEOVER**

- .1 After the second occurrence of the term "Ready-for-Takeover" insert before the term "Ready-for-Takeover" in paragraph 12.1.3 the words "determination of".

**.2 GC 12.2 EARLY OCCUPANCY BY THE OWNER**

- .1 Delete the word "achieve" in paragraph 12.2.4 and replace it with the words "have achieved".

**.3 GC 12.3 WARRANTY**

- .1 Delete the word "The" from the first line of paragraph 12.3.2 and replace it with the words "Subject to paragraph 3.9.1, the".
- .2 Amend Paragraph 12.3.3 by adding the following sentence: "The warranty period for corrected work shall commence on the date of acceptance of the correction."

**PART 13 INDEMNIFICATION AND WAIVER**

**.1 GC 13.1 INDEMNIFICATION**

- .1 Revise Paragraph 13.1.3 by deleting the words 'paragraphs 13.1.1 and 13.1.2' and replacing them with 'paragraphs 13.1.1, 13.1.2 and 13.1.7'.
- .2 Add new paragraph 13.1.7 as follows:
- "13.1.7 The Contractor shall indemnify and hold harmless the Consultant, its sub-consultants, agents and employees from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings by third parties that arise out of, or are attributable to the Contractor's performance of the Contract, provided such claims are:
- .1 attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property, and
- .2 caused by negligent acts or omissions of the Contractor or anyone for whose negligent acts or omissions the Contractor is liable, and
- .3 made by Notice in Writing within a period of 6 years from the Ready-for-Takeover date or within such shorter such period as may be prescribed by any limitation statute or the Province or Territory of the Place of Work."

**PART 14 MISCELLANEOUS**

- .1 Add PART 14 – **MISCELLANEOUS** as follows:

**"PART 14 MISCELLANEOUS**

**.2 GC 14.1 OWNERSHIP OF MATERIALS**

14.1.1 Unless otherwise specified in the Contract Documents, all materials existing at the Place of the Work at the time of execution of the Contract shall remain the property of the Owner. All work and Products delivered to the Place of the Work by the Contractor its subcontractors, or suppliers shall be the property of the Owner.

**.3 GC 14.2 AS-BUILT DRAWINGS**

14.2.1 As the Work progresses, the Contractor shall maintain a complete and accurate record of all changes and deviations from the Contract Documents clearly indicating the Work as actually built and installed. The Contractor shall require its Subcontractors to

maintain and provide accurate, complete as-built drawings for their portions of the Work. The as-built record drawings shall be kept at the Place of the Work for review by the Consultant and/or the Owner.

14.2.2 Prior its application for Final Payment of the Work pursuant to GC 5.5 FINAL PAYMENT, the Contractor shall deliver the as-built drawings referred to in 14.2.1 in one hard copy and electronically in pdf to the Owner.

14.2.3 In addition to the foregoing, the Contractor shall transfer the information obtained per 14.2.1 to as-built CAD drawings in AutoCAD v 2020 min and provide to the Owner prior to its application for Final Payment of the Work pursuant to GC 5.5 FINAL PAYMENT. The Contractor shall deliver the CAD record of as-built drawings referred in two printed sets (hard copies) and electronically in AutoCAD to the Owner. The CAD As-Built Drawings shall be properly labelled per each discipline, drawings name, date, etc. and shall be created with proper layering according to AIA standard layering conventions.

**.4 GC 14.3 APPLICABLE LAWS AND COUNTY POLICIES**

13.5.1 The Contractor shall fully comply with any policies or procedures of the Owner which are relevant to any activity of the Contractor to be performed under the Contract. The Contractor further agrees that it will use reasonable efforts to inquire from the Owner if such Owner policies or procedures exist for any activity of the Contractor to be performed under the Contract. The Owner agrees that it will use reasonable efforts to communicate to the Contractor policies or procedures it may have, relevant to any such activity.

**.5 GC 14.4 APPROVAL, CERTIFICATION, INSPECTION, REVIEW**

14.4.1 No approval of, or certification, inspection, review, comment, verification, confirmation, acknowledgement or audit by, any Governmental Authority, the Owner, or the Consultant, or anyone on their behalf, shall relieve the Consultant from performing or fulfilling any of its obligations under the Contract. Without limitation, whenever any work product of the Contractor related to the Work requires any review, inspection, comment or approval by any Governmental Authority, the Owner, or the Consultant, or anyone on their behalf, any such review, inspection, comment or approval shall not, in any way, reduce or modify any of the Contractor's obligations under the Contract."

**END OF SECTION**

## **1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 The Work includes construction of a new fire station in accordance with the requirements of the Drawings and Specifications.
- .2 General Contractor is responsible for obtaining and payment of any and all permits applicable to the project work.

## **1.2 METHOD OF PROJECT DELIVERY**

- .1 Construct Work under CCDC 2-2020 stipulated price contract as amended by supplementary conditions, as published in Section 00 80 00 - Supplementary Conditions, and the "Special Provisions" as published in the Request for Tender document.

## **1.3 DEFINITIONS**

- .1 Notwithstanding definitions specified elsewhere, the following definitions take precedence and govern specification divisions 01 through 33 inclusive of the Contract Documents. In the event of conflict, the following shall govern.
  - .1 Owner: means 'Corporation of the County of Brant'.
  - .2 Contractor: means the party identified as such in the Agreement of the CCDC 2 Contract, inclusive of their relevant office and field staff, project manager, site supervisor, and all Subcontractors and Suppliers assigned a part or parts of the Work.
  - .3 Air Control: This layer prevents air leakage in excess of defined limits into or out of the building, improving energy efficiency and indoor air quality. Air barriers, typically located near the exterior of the wall or roof, are designed to resist airflow.
  - .4 Thermal Control: This layer manages heat transfer, aiming to maintain a comfortable indoor temperature by reducing heat loss in winter and heat gain in summer. Insulation is the primary component of this layer, and it can be supplemented by proper insulating glass unit design.
  - .5 Vapour Control: This layer manages the movement of water vapour through the enclosure, preventing condensation and moisture damage. Vapour barriers or retarders, located on the interior side of the insulation, slow down the diffusion of water vapour.
  - .6 Water Control: This layer prevent liquid water intrusion in excess of defined limits from rain, snow, or ground moisture. It includes components like the drainage plane, water-resistive barrier (WRB), and flashing, all designed to shed water away from the building's structure.
  - .7 And/or: 'and/or' means that the sentence in which it appears should be read twice to extract the complete meaning, once with the conjunction 'and' used, and once with the conjunction 'or' used.
  - .8 Equivalent: means a material or product that has the same or better performance characteristics, physical properties, warranty provisions, and technical support as the specified material or product, and has been accepted in accordance with the requirements of Section 01 25 00.
  - .9 May: 'may' is used to express an option or that which is permissible within the limits of the Contract.
  - .10 Must: 'must' is used in the specifications to indicate a requirement that is contractually binding, meaning it is required to be implemented, and its implementation verified; it has the same contractual purpose as 'shall' in the specifications.
  - .11 Place of the Work: means the location of the Work identified in the Contract Documents.

- .12 Product: means material, machinery, equipment, and fixtures forming the Work.
- .13 Project Team: all the parties involved in the Project, including Owner, Consultant, Contractor, Subcontractors and Suppliers.
- .14 Project: means the total construction contemplated of which the Work may be the whole or a part.
- .15 Provide: means that the Work concerned shall include any delegated design necessary for, and the supply and installation of, the products required for completion of that part of the Work.
- .16 Shall: 'shall' is used in the specifications to indicate a requirement that is contractually binding, meaning it is required to be implemented, and its implementation verified.
- .17 Should: 'should' is used in the specifications to indicate a goal that must be addressed by the Contractor but is not formally verified. The Contractor is required to communicate to the Consultant at progress meetings how they are intending to achieve the goal and what progress they have made.
- .18 Supplier: means person or entity having direct contract with Contractor, trade contractor or subcontractor, or to supply Products.
- .19 Subcontractor: means person or entity having direct contract with Contractor to perform a part or parts of the Work at the Place of the Work.
- .20 Will: 'will' is used in the specifications to indicate a statement of fact.
- .21 Work: means the total construction or a part or parts thereof and related services required by the Contract Documents.

#### 1.4 DEFINED TERMS

- .1 The parties to the *Contract* agree that a term found defined in DEFINITIONS of the *Contract Documents* and used in the *Specifications*, whether appearing in regular font or in italics or capitalized or not, shall have the meaning of that defined term.

#### 1.5 COMPLEMENTARY DOCUMENTS

- .1 Drawings, specifications, and schedules are complementary each to the other and what is called for by one to be binding as if called for by all. Should any discrepancy appear between documents which leaves doubt as to the intent or meaning, abide by Precedence of Documents article below or obtain direction from the Consultant.
- .2 Examine all discipline Drawings, Specifications, and related documents to ensure that Work can be satisfactorily executed. Conflicts or additional work beyond work described to be brought to attention of Consultant.
- .3 Drawings must be read and interpreted in their entirety. If a detail, material, specification, dimension, and other information included on Drawings is shown on one drawing, it is as if shown on all Drawings. Where information and instructions is located in the Contract Documents is at the sole discretion of the Consultant.



## **1.6 COORDINATION AND COOPERATION**

- .1 The general *Contractor* and pre-engineered metal building contractor shall coordinate and cooperate with each other as required to ensure that the North Paris Fire Station project is finished on time, on budget and in accordance with the Drawings and Specifications.
- .2 *Subcontractors* and *Suppliers* shall cooperate with each other in carrying out their respective works as required to maintain Construction Schedule and eliminate inefficiencies and carry out instructions of *Contractor* and *Consultant*.
- .3 *Subcontractors* and *Suppliers* shall coordinate work with that of other *Subcontractors* and *Suppliers* as required to maintain Construction Schedule and eliminate inefficiencies. If any part of the *Work* subcontracted depends for its proper execution or result upon *Work* of another subcontract, report promptly in writing any constraints that may interfere with proper and timely execution of the *Work* contracted to *Contractor* and *Consultant*.
- .4 Coordination and cooperation between *Subcontractors* and *Suppliers* is required.
- .5 Coordinate use of worksite and property under direction of *Contractor* and *Consultant*.
- .6 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

## **1.7 PERMITS**

- .1 The Owner will obtain the Building Permit; all other permits and requirements of authorities having jurisdiction by Contractor.

## **1.8 POST-DISASTER BUILDING**

- .1 The fire station is classified under the OBC as having a post-disaster importance factor, and must be designed to remain safe, functional and accessible after a disaster in accordance with the OBC.
- .2 The site qualifies as a seismic Site Class D according to the geotechnical report and the structural design Drawings.
- .3 Seismic Hazard Index  $1E_{Sa} (0.2) = 0.428$ .
- .4 Seismic Force Modification Factors for seismic force resisting systems:
  - .1  $R_d = 2.0$ .
  - .2  $R_o = 1.3$ .
- .5 Refer to the structural design drawings for seismic loading design data.
- .6 Ensure that the as-built construction accommodates OBC seismic considerations; have a delegated design structural engineer (P.Eng.), in accordance with the requirements of Section 01 35 01 - Delegated Design, design and reviewed engineered Shop Drawings that detail connections to structure, and the erection, placement and installation of structural elements.
- .7 Seismic Considerations:
  - .1 Per Section 4.1.8.18 (2) of the OBC, the building requires seismic bracing and anchorage. The affected parts of the Work include but are not limited to the following:
    - .1 Suspended ceilings and light fixtures,
    - .2 Masonry veneer connections
    - .3 Machinery, equipment, ducts and tanks,
    - .4 Pipes, cable trays, conduit.

- .5 Other parts of the Work which might become dislodged or damaged during an earthquake and compromise the safety, accessibility or useability of the building in a post-disaster circumstance.
- .2 The prescriptive masonry veneer tie spacing given in CSA Standard A370, cannot be used. The ties must be engineered by Contractor's delegated design P.Eng. per Section 01 35 01 - Delegated Design.
- .3 Unreinforced masonry is not permitted; refer to CSA S304:24, Design of Masonry Structures.
- .4 Minimum amounts of reinforcement are required for all loadbearing and lateral load-resisting masonry, masonry used around stairwells and elevators and exterior cladding (excluding veneer), and certain partitions; refer to CSA S304:24, Design of Masonry Structures.
- .5 Composite and multi-wythe solid walls must have grouted collar joists and ties; refer to CSA S304:24, Design of Masonry Structures.
- .6 The empirical design method for masonry cannot be used – all masonry must be engineered; refer to CSA S304:24, Design of Masonry Structures.

## 1.9

### DOCUMENTS REQUIRED

- .1 Keep the following documents at Place of the Work, stored securely and in good order and available to Owner and Consultant in hard copy or electronic form:
  - .1 Current Contract Documents, including Drawings, Specifications and addenda.
  - .2 Change Orders, Change Directives, and Supplementary Instructions.
  - .3 Reviewed Shop Drawings, Product data and samples.
  - .4 List of outstanding Shop Drawings.
  - .5 Field test reports and records.
  - .6 Construction progress schedule.
  - .7 Meeting minutes.
  - .8 Manufacturer's certifications.
  - .9 Permits, inspection certificates, and other documents required by authorities having jurisdiction.
  - .10 Current as-built drawings.
  - .11 Safety Data Sheets (SDS).
  - .12 Copy of accepted Project Schedule.
  - .13 6-week look-ahead schedule.
  - .14 Other documents as required by authorities having jurisdiction.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract.
- .2 Project Supplementary Conditions

**1.2 CASH ALLOWANCES**

- .1 Refer to CCDC 2, GC 4.1.
- .2 Include in Contract Price specified cash allowances.
- .3 Cash allowances, unless otherwise specified, cover net cost to Contractor and subcontractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation and other authorized expenses incurred in performing Work.
- .4 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- .5 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .6 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.
- .7 Include progress payments on accounts of work authorized under cash allowances in Consultant's monthly certificate for payment.
- .8 Prepare schedule jointly with Consultant and Contractor to show when items called for under cash allowances must be authorized by Consultant for ordering purposes so that progress of Work will not be delayed.
- .9 Amounts specified are exclusive of HST (HST extra).
- .10 Amount of each allowance, for Work specified in respective specification Sections is as follows:
  - .1 Supply of Fixtures & Equipment \$225,000.  
(installation by GC in contract price):
    - .1 Gear Drying Racks (x2)
    - .2 Extractors (x2)
    - .3 SCBA Tank Fill Station
    - .4 Wire Bunkers
    - .5 Library Kiosk & Book drop box
    - .6 Televisions
    - .7 Appliances
    - .8 Base radio system
  - .2 Furniture and Blinds \$75,000
  - .3 Commissioning \$25,000.
  - .4 Security \$30,000.
  - .5 Door Hardware \$25,000.
  - .6 Interior Signage: \$25,000.
  - .7 Photovoltaic System: \$300,000.

**END OF SECTION**

**Part 1 General**

**1.1 DEFINITION**

- .1 An 'Alternative' is anything (e.g. a product, an installation, a design, a requirement, a scope of work, etc.) that is separately priced by bidders to provide options to the Owner in determining what the Work of the Contract will actually be.
  - .1 Alternate Price: The amount stipulated by the Bidder for an alternative, which can be stated as an addition, a deduction, or no change to the base Bid Price.
  - .2 An Alternative Price item can be included in the Contract Price if added by the issuance of a post-tender addendum prior to the execution of the Agreement; it can also be added to the Contract Price after the Contract has been executed by issuance of a Change Order. Unless incorporated by written agreement between the parties to the Contract, an Alternate Price item is not included in the Contract Price.

**1.2 REQUIREMENTS**

- .1 Referenced specification Sections stipulate pertinent requirements for products and methods to achieve Work stipulated under each Alternative Price item.
- .2 Coordinate affected related Work and modify surrounding Work to integrate Work under each Alternative Price item.

**1.3 AWARD AND SELECTION OF ALTERNATIVES**

- .1 Provide alternative pricing in accordance with section 00 21 13 – Request for Tender.
  - .1 Indicate variation to Bid Price for Alternative Price items described below. Identify the effect on the Bid Price if the Alternative Price item is elected by the Owner.
  - .2 Bids will be evaluated based on the submitted Bid Price and not on the Alternate Price items. After determination of preferred Bidder, consideration will be given to Alternative Prices and Bid Price adjustments.
  - .3 Do not include Alternative Prices in Bid Price and do not include HST.

**1.4 ALTERNATIVES**

- .1 Alternative Price No. 1: Masonry Walls and Partitions:
  - .1 Base Bid: Use normal weight and lightweight concrete masonry units to construct masonry walls and partitions designated to remain exposed, as specified in Section 04 22 00 - Unit Masonry, complete with site-painted finish as specified in Section 09 91 00 - Painting.
  - .2 Alternative: Use CarboClave concrete masonry units by Brampton Brick Limited to construct masonry walls and partitions designated to remain exposed, as specified in Section 04 22 00 - Unit Masonry. Do not site paint CarboClave concrete masonry units. Apply clear liquid moisture repellent finish on CarboClave masonry walls in Rooms 117, 118, 119.

- .2 Alternative Price No. 2: Kitchen Countertops:
- .1 Base Bid: Quartz surface countertops in accordance with the Drawings and as specified in Section 06 40 00 - Architectural Woodwork.
  - .2 Alternative: custom-fabricated stainless steel countertop with integral sink and backsplash as specified in Section 05 50 00 - Metal Fabrications. Refer to plumbing fixture schedule on the mechanical Drawings and replace fixture type DS-1 with countertop-integrated stainless-steel sink and backsplash. This applies only to the section of countertop with the sink. Coffee counter and island to remain quartz.
- .3 Alternative Price No. 3: Batt Insulation for Wall types W-EX1, W-EX2, W-P2a and W-P2b:
- .1 Base Bid: Fibreglass batt insulation in accordance with the Drawings and as specified in Section 07 21 16.10 – Fibrous Insulation.
  - .2 Alternative: Mineral wool batt insulation as specified in Section 07 21 16.10 – Fibrous Insulation.
- .4 Alternative Price No. 4: Washroom Lavatory Station:
- .1 Base Bid: SloanStone® ELC-82000 Solid Surface 2-Station Wall-Mounted Counter Top Sink, to Section 06 40 00 - Architectural Woodwork. Work includes a wall-mounted 2-sink station, installation of L1 fixtures as specified in mechanical Drawings plumbing fixture schedule, and installation of standalone soap dispenser SD-1 as specified in architectural Drawings, and as per Section 10 28 10 - Toilet and Bath Accessories.
  - .2 Alternative: Sloan® DSG-82000 Designer Series™ 2-Station Wall-Mounted Gradient Sink with faucets complete with integrated soap dispensers, Colour: Carbon Concrete. Provide Vertical Cabinet Style Laminated Doors, Colour: Fawn Cypress Laminate. Faucets: BASYS® Hardwired-Powered Deck-Mounted Mid Body Faucet complete with integrated Sloan® ESD-400 Foam Soap Dispensers. Do not provide standalone soap dispenser SD-1.
- .5 Alternative Price No. 5: Bunker Gear Room 109 Flooring:
- .1 Base Bid: polyurethane/epoxy flooring as shown on Drawings and as specified in Section 09 67 00 - Fluid Applied Flooring.
  - .2 Alternative: Polished concrete flooring, as specified in Section 03 35 44 - Refined Concrete Finishing with resilient rubber base as specified in Section 09 65 00 - Resilient Base and Accessories.
- .6 Alternate Price No. 6: Casework:
- .1 Base Bid: custom shop-fabricated casework, to Section 06 40 00 Architectural Woodwork.
  - .2 Alternative: Provide premanufactured/prefabricated casework that meets the project design intent as per Drawings and Specifications. If accepted, they must be built to suit field conditions and meet the design intent as per Drawings and Specifications, including dimensions and function. Submit all documentation, colour samples and images as required for a comprehensive review.

**END OF SECTION**

## **1.1 DEFINITIONS**

- .1 In this Section "Substitution" means a Product, a manufacturer, or both, not originally specified in Contract Documents by proprietary name but proposed for use by Contractor in place of a Product, a manufacturer, or both, specified by proprietary name.

## **1.2 SUBSTITUTION PROCEDURES**

- .1 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s), unless there is accompanying language indicating that Substitutions will not be considered.
- .2 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s) and accompanied by language such as "or equal", "or approved equal", or other similar words. Do not construe such language as an invitation to unilaterally provide a Substitution without Consultant's prior acceptance in writing. Do not order or install any Substitution without a Supplemental Instruction or Change Order.
- .3 Provided a proposed Substitution submission includes all of the information specified in this Section under Submission Requirements For Proposed Substitutions, Consultant will promptly review and accept or reject the proposed Substitution.
- .4 Consultant may accept a Substitution if satisfied that:
  - .1 the proposed substitute Product is the same type as, is capable of performing the same functions as, interfaces with adjacent work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations, of the specified Product,
  - .2 the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and
  - .3 the Substitution provides a benefit to Owner.
- .5 If Contractor fails to order a specified Product or order a Product by a specified manufacturer in adequate time to meet Contractor's construction schedule, Consultant will not consider that a valid reason to accept a Substitution.
- .6 If Consultant accepts a Substitution and subject to Owner's agreement, the change in the Work will be documented in the form of either a Supplemental Instruction or Change Order as specified in Section 01 26 00 - Contract Modification Procedures.
- .7 If a Substitution is accepted in the form of a Supplemental Instruction or Change Order, Contractor shall not revert to an originally specified Product or manufacturer without Consultant's prior written acceptance..

## **1.3 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS**

- .1 Include with each proposed Substitution the following information:
  - .1 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.
  - .2 Reason(s) for proposing the Substitution.
  - .3 A statement verifying that the Substitution will not affect the Contract Price and Contract Time or, if applicable, the amount and extent of a proposed increase or decrease in Contract Price and Contract Time on account of the Substitution.
  - .4 A statement verifying that the Substitution will not affect the performance or warranty of other parts of the Work.
  - .5 Manufacturer's Product literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.

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

**END OF SECTION**

## **1.1 SUMMARY**

- .1 This Section includes administrative and procedural requirements for Requests for Information (RFIs).

## **1.2 DEFINITIONS AND PROCEDURES FOR ACCEPTANCE OF RFIs**

- .1 Request for Information (RFI): A formal process used during the construction phase of the project to facilitate communication between the Contractor, Consultant and Owner with regards to requests for additional information about the content of the Contract Documents as follows:
  - .1 Contractor will identify RFIs for two specific categories of request as follows:
    - .1 Requests for Interpretation: Request made in accordance with contractual obligations for Consultant's third-party obligations for providing interpretations of the Contract Documents listed in Article A-3 of the Agreement; Consultant will not provide an interpretation for questions arising from documents that are not contained in the listed Contract Documents.
    - .2 Requests for Clarification: Request concerning items not indicated on Drawings or contained in Specifications; requests relating to items that cannot be ascertained after Contractor has exhausted their due diligence to locate required information and, that is not apparent in the Contract Documents or subsequent to site reviews performed by the Contractor, and that is required to perform the Work.
  - .2 Consultant's response to an RFI has the same status as a 'Supplemental Instruction' as defined under the Definitions of Contract.
- .2 Request for Information Form: A standard document provided by the Consultant and submitted by the Contractor requesting interpretation or clarification to the Drawings and Specifications. Properly prepared RFIs will be considered by the Consultant when they contain the following information:
  - .1 Reference Drawing sheet number, drawing name and number.
  - .2 Reference Specification Section number, Section title, and paragraph numbers.
  - .3 Provide detailed written statements clearly stating the nature of the interpretation or clarification requested.
  - .4 Outline conditions that are different from those indicated within Contract Documents.
  - .5 Contractor's suggested solution where request impacts construction means, methods, techniques, sequences and procedures, or as required for coordinating the various parts of the Work.
- .3 Improper RFIs: RFIs that contain ambiguous language, errors, or incomplete information that does not identify specific components of the Drawings or Specifications, or that is sent to a party other than the Consultant.
  - .1 Consultant will notify the Contractor before processing an Improper RFI.
  - .2 The Owner reserves the right to invoice the Contractor for the processing of improper RFIs by the Consultant at standard per diem rates charged to the Owner.
  - .3 Owner will deduct these costs from Progress Payments due to the Contractor.
- .4 Unnecessary RFIs: RFIs will not be accepted that contain requests for information that is apparent within the Contract Documents or reasonably inferable; that is apparent from site observations; or contains information that entails change of contractual responsibility;



change of design; that is vague or ambiguous; or that asks for a response to shop drawings and substitutions.

- .1 Vague or Ambiguous RFIs: Requests that are vague or ambiguous (unintentionally or intentionally) and that cannot be interpreted by the Consultant as an Improper RFI, or that cannot be clarified by additional information provided by the Contractor.
- .2 Change of Design: Requests that change the design beyond that suggested by Drawings and Specifications, and which could be anticipated through normal investigation of constructability.
- .3 Change of Contractual Responsibility: Requests that requires Consultant to provide information relating to construction means, methods, techniques, sequences and procedures, or coordinating the various parts of the Work that are the responsibility of the Contractor.
- .4 Work Done: Requests that confirm work already performed or that imply confirmation of unauthorized changes will not be accepted.
- .5 Untimely Submissions: Requests that are submitted without consideration for timely response based on complexity of interpretation or clarification required.
- .6 Submittals and Substitutions: Requests that contain shop drawings product data, or that indicate a substitution of products.
- .7 Incomplete: Requests that do not consider coordination and scheduling of related work components, and that do not contain Contractor's proposed solutions.
- .8 Exclusionary: Requests that imply that specific portions of the Contract Documents are excluded or considered as separate or isolated portions of the Contract Documents; or components taken out of context with other available information contained within the Contract Documents.
- .9 Unacceptable Requests: Requests that are inherently considered as normal questions contained on submittals (shop drawings, product data or similar documents), requests for substitution or requesting changes that are known to entail additional costs (change order requests), and that can be administered using appropriate Contract modification documents.
- .10 Excessive Requests: Unreasonable quantity of, or unnecessary submissions beyond that established as a baseline for the Work with a corresponding reduction of response period request from the Contractor:
  - .1 Consultant recognizes that RFI process accounts for variations in numbers of RFI throughout the construction delivery phase of the project and is a normal part of the communication process.
  - .2 Excessive requests are considered those that do not recognize the Consultant's ability to process and return RFI's within a reasonable response period and that appear to be an attempt to circumvent the baseline.
  - .3 Consultant will return excessive requests and note "The Consultant will not accept unreasonable quantities or time limits placed on demands for responses", or similar wording.
- .11 Derogatory Requests: Requests that imply non-existent errors or omissions in the Contract Documents; that discredit the Consultant's competency while promoting the Contractor's mastery of the construction process out of proportion to roles and responsibilities provided within the Contract.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meetings: Conduct a pre-construction meeting attended by the Contractor, the Consultant, and Owner in accordance with Section 01 31 19 – Project Meetings to discuss the following:
  - .1 Review Consultant's RFI form and required content for timely response, limitations of content, categories of requests that will be considered as valid RFIs.
  - .2 Review Consultant's submission requirements, name and email address of primary contact and mode of transmission (fax, email, FTP site).
  - .3 Review Consultant's process for receiving, handling and responding to RFIs including the following:
    - .1 Consultant's prime contact for accepting and dispersing RFIs, and out-source responsibility to Subconsultants and specialist consultants.
    - .2 Confirmation of reasonable response times necessary to process and complete RFIs.
    - .3 Electronic project management software, submission processes and record keeping requirements.
  - .4 Establish a baseline for reasonable quantities of RFI submissions based on project circumstances and complexities, and methods for discussing adjustments to timeframes for processing requests during peak request periods.
  - .5 Review methods to resolve complex issues arising from RFI process; discuss methods for prioritizing critical responses and establishing mutually acceptable response times where multiple RFIs are issued.
- .2 Coordination: Coordinate requirements for timely response period based on number or complexity of RFIs issued during the course of the Work:
  - .1 Consultant will endeavor to respond within 5 Working Days or other time frame agreed upon prior to issuing any RFIs:
    - .1 Complex requests may take 5 Working Days or longer.
    - .2 Requests requiring Subconsultant input may take more than 5 Working Days.
    - .3 Consultant will request additional response time where multiple RFIs are received within a short period of time.
  - .2 RFIs received after 2:00pm will be considered as received on the following Working Day.
  - .3 Consultant's response may include a request for additional information from the Contractor, which will result in a mutually agreed upon increase to the time required to respond to the RFI.
  - .4 RFI must state a date and time where need for response is different than indicated by the Consultant, or where greater urgency is required by the Contractor or Subcontractor.
  - .5 Consultant's stated response time or other time proposed by Subcontractor or the Contractor does not represent a guarantee that RFIs will be addressed within the stated time period.
- .3 Record Keeping: Contractor is responsible for preparing and maintaining a log of RFIs and providing a copy to the Consultant when requested indicating any unanswered, incomplete or outstanding RFIs:
  - .1 Use RFI Log during project meetings and identify an agenda point during regular site meetings to discuss status of pending and upcoming RFIs.

- .2 Consultant will maintain a similar record of responses to RFIs, indicating a log of actions or reasons for non-response based on definitions contained in this Specification section.

#### **1.4 COMPLETION OF THE STANDARD RFI FORM**

- .1 Prior to the commencement of any work whose scope is affected by an RFI, fill out the RFI form for submission as follows:
  - .1 Complete the standard RFI form prepared by Consultant based on the example document attached to this Specification section:
    - .1 Indicate correct use of Interpretation or Clarification based on definitions listed above.
    - .2 Complete all required entry items; handwritten entries must be fully legible after photocopying, scanning or facsimile transmission (fax).
    - .3 Include one topic for each RFI, submitted in chronological order with no breaks in consecutive numbering.
    - .4 Label each page of attachments with RFI number.
    - .5 Submit completed RFI using the accepted mode of transmission discussed at the preconstruction meeting..

#### **1.5 CONDITIONS FOR INITIATING RFIs**

- .1 Validity of Request: Consultant will accept requests when one or more of the following conditions have been met by the Contractor:
  - .1 Proper Review:
    - .1 Do not issue RFIs to Consultant without first carefully reviewing the Specifications and Drawings to find the information and answers sought.
    - .2 Do not forward questions to the Consultant from Subcontractors or Suppliers without first carefully reviewing the Specifications and Drawings to find the information and answers sought.
    - .3 The Owner, with the advice of Consultant, and at Owner's sole discretion, reserves the right to charge for Consultant's time spent responding to 'Unnecessary RFIs' at the hourly rate of \$250.00 (HST extra), with the intent of paying Consultant for their time, at no additional cost to Contract.
  - .2 Pre-Submission Review: Contractor to review requests from Subcontractors, manufacturers and suppliers before submitting any RFI to determine whether request is valid.
  - .3 Need for Interpretation: Contractor or Subcontractor requires additional information arising from disconnects within Contract Documents, and where intent cannot be reasonably inferred from information presented in the Specifications and Drawings such as the following:
    - .1 Interpretation will occur when inconsistencies arise from differing information components leading to contradictions between parts of the Contract Documents.
    - .2 Interpretation will occur to address omissions, differences in coordination, or contradictions for placement of components indicated on Drawings and Specifications that lead to uncertainty of intent contained within the Contract Documents.
  - .4 Need for Clarification: Contractor is unable to determine material or system required for project from the Contract Documents, or where site conditions or circumstances are different from those indicated within the Contract Documents.

- .2 Unanswered Bid Enquiries from Bid Period: Bid Enquiries during the bidding period are not considered RFIs and as such may not have been completely addressed through the addendum or bid revision process:
  - .1 Consultant informs the Contractor that complexity of a Bid Enquiry or timeliness of a submission may delay or cause an incomplete response requiring additional interpretation or clarification during course of the Work.
  - .2 It is expected that any outstanding or incomplete enquires arising from the Bid period will be submitted in the form of an RFI immediately upon award of Contract so that suitable responses can be provided by the Consultant.

## 1.6 RFI SUBMISSION PROCEDURES

- .1 Initiating an RFI: Contractor may; after exercising due diligence to locate required information, request clarification or interpretation of the requirements of the Contract Documents:
  - .1 Consultant will attempt to respond with reasonable promptness; however, if the information requested by Contractor is readily apparent from site observations, is contained in the Contract Documents or is reasonably inferable from them, the Contractor will be responsible to the Owner for reasonable costs charged by the Consultant for additional services required to provide such information.
- .2 Alternative to RFIs: Determine urgency of Request for Information; and wherever possible, include request for interpretation or clarification as a component of the next regularly scheduled Project Meeting:
  - .1 Consultant will endeavour to provide a response as a component of the meeting minutes.
  - .2 Consultant will accept that a special Project Meeting may be required to discuss coordination of complex or numerous RFI points within a regularly scheduled Project Meeting.
  - .3 Submit an RFI where item cannot be addressed during meeting, or where urgency of need or complexity of item cannot be adequately addressed during Project Meeting.
- .3 Completion of Standard RFI Form: Prepare Consultant's standard RFI form by completely filling in all required fields and clearly stating the nature of the request:
  - .1 Attach additional or covering information necessary to provide clarity to request and submitting in a timely manner, or that does not fit on the standard form provided by the Consultant.
  - .2 Accompany RFIs issued for coordination issues of items like pipe and duct routing, or clearances for other work shown diagrammatically requiring specific locations by including drawings or sketches drawn to scale indicating suggested solutions.
- .4 Acceptance of RFIs: RFIs will only be accepted from Contractor as follows:
  - .1 All Subcontractor RFIs must be sent to Contractor; RFIs sent directly to Consultant by Subcontractor without Contractor's prior review will not be accepted and will be returned unanswered.
  - .2 RFIs sent directly to Subconsultants by Subcontractors or Contractor will not be accepted and will be returned unanswered; unless agreed to before submission of RFI.
  - .3 Include requests from Subcontractors, manufacturers and suppliers as a part of Contractor submission.

- .4 RFIs received by Consultant that are sent directly from any Subcontractor, manufacturer and supplier; and that are not a part of the Contractor's RFI, will be returned unanswered.
- .5 Contract Changes Resulting from RFI Responses: Consultant will respond to properly prepared RFIs with the assumption that no change to Contract Price or Contract Time is involved with RFIs:
  - .1 Notify Consultant immediately about any concerns arising from Consultant's response that has potential to affect Contract Price or Contract Time.
  - .2 Do not prepare RFIs with the anticipation that responses will automatically justify increased Contract Price or extensions to Contract Time.
  - .3 Do not proceed with any work associated with the affected RFI until a Change Order is prepared and approved, or a Change Directive is issued where urgency for continuation of the Work dictates.
  - .4 Claims for change to Contract resulting from a failure to identify affects to Contract Price or Contract Time within 10 Working Days from issue of response from Consultant will not be considered by the Owner.

#### **1.7 RESPONDING TO RFIs**

- .1 Consultant will respond to properly prepared RFIs by one of the following methods:
  - .1 Directly on the submitted form or using additional attachments as appropriate to address concerns identified where no change to the Contract is anticipated.
  - .2 Retaining original RFI and issuing a Proposed Change Notice where Contractor indicates that a change to Contract is required.
  - .3 Respond by indicating that additional information or additional time is required to address the subject indicated in the RFI.
  - .4 Completion of response will close the RFI.
- .2 Consultant will identify Improper RFIs to Contractor before responding, and will attempt to respond where content does not relate to means and methods for delivery of the Work:
  - .1 Improper RFIs that cannot be reasonably interpreted by the Consultant will be treated the same as Unnecessary RFIs.
  - .2 Return of Improper RFI will close the RFI.
- .3 Consultant will return Unnecessary RFIs directly to Contractor unanswered with a notation Not Reviewed accompanied by wording stating specific reasons and follow-up action where required:
  - .1 Return of Unnecessary RFI will close the RFI.
  - .2 Contractor or Subcontractor can disagree with Consultant's response to a properly prepared RFI, or any assessment of RFIs considered by the Consultant as Improper or Unnecessary at any time during the communication process; disagreement will result in closing the current RFI and initiation of a meeting to discuss further resolution.

**END OF SECTION**

**REQUEST FOR INFORMATION (RFI)**

# \_\_\_\_\_

**Project Name:**

\_\_\_\_\_

**Project Location:**

**Project Number:**

\_\_\_\_\_

**Requesting Party**

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

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

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

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

Phone: \_\_\_\_\_

**Assigned to:**

**Co-Reviewers:**

\_\_\_\_\_

**DETAILS**

RFI Title: \_\_\_\_\_

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

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

Action Required: Clarification Approval Other \_\_\_\_\_

**Priority:** ☐ High ☐ Normal ☐ Unknown

**Cost Impact:** ☐ Yes ☐ No ☐ Unknown

**Schedule Impact:** ☐ Yes ☐ No ☐ Unknown

**Question:**

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**Suggested Answer:**

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**REFERENCES**

Discipline:

Category: ☐ Code Compliance ☐ Design Coordination ☐ Documentation Incomplete  
☐ Constructability ☐ Documentation Conflict ☐ Field Condition

Other: \_\_\_\_\_

**RESPONSE**

**Official Response:**

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**Responder Name**

**Responder Company**

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**Response Date**

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**Signature**

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## **1.1 REFERENCES**

- .1 Owner/Contractor Agreement.
- .2 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract.

## **1.2 DEFINITIONS**

- .1 Statutory Holdback: a "statutory holdback" is the lien holdback mandated by the Ontario Construction Act for the protection of Subcontractors and Suppliers.
- .2 Deficiency Holdback: a "deficiency holdback" refers to a portion of the contract price withheld by the Owner as security for the correction of deficiencies or incomplete work. The intention is to incentivize the completion of work according to the Contract Drawings and Specifications.
- .3 Maintenance Holdback: a "maintenance holdback" refers to a portion of the contract price withheld by the Owner as security for performance of post-construction maintenance or warranty work during the Contract warranty period.

## **1.3 PAYMENT PROCEDURES – GENERAL**

- .1 Refer to CCDC 2, **GC 5.2**.
- .2 Progress claims to be submitted monthly (once per month).
- .3 Submit progress claims via email.
- .4 Progress claims must include a current and valid Certificate of Insurance.
- .5 Progress claims must include a signed Statutory Declaration.
- .6 10% Statutory Holdback will be applied to each progress claim Subtotal for the purposes of the Ontario Construction Act.
- .7 In addition to the 10% Statutory Holdback, the following additional holdbacks will be applied to each progress claim Subtotal:
  - .1 2% Deficiency Holdback, to be released upon correction of defective work found during Consultant's review for certification of Substantial Performance. A determination that defective work has been corrected and complies with the Drawings and Specifications as may have been amended by Change Order will be made by Consultant and confirmed in writing to Owner and Contractor.
  - .2 3% Maintenance Holdback, to be released at the conclusion of the 2-year warranty period.
- .8 Submit to Consultant, at least 15 calendar days before first application for payment, a Schedule of Values for the parts of the Work for review and approval. The Schedule of Values format shall include previously claimed, current claim, and remaining per Schedule of Values scope line item, identified in both cost (\$CAD) and % complete.
- .9 Approved Change Orders shall be invoiced as part of the monthly progress claim. Approved Change Orders shall be identified separately with one Change Order per line item.
- .10 Approved Cash Allowance Work shall be invoiced as part of the monthly progress claim. Approved Cash Allowance Work shall be identified separately with one Cash Allowance item per line.
- .11 Work performed under Change Directive shall not be invoiced and submitted for payment until the amount agreed upon by Owner and Contractor has been recorded by issuance of a Change Order.



- .12 Submittal of progress claims for materials stored off site not permitted.
- .13 Consultant team will review the Work and materials stored on site to validate progress claims.
- .14 Each application for payment shall include evidence of compliance with workers' compensation legislation at the Place of the Work and after the first payment, a declaration by the Contractor as to the distribution made of the amounts previously received using document CCDC 9A 'Statutory Declaration'.

#### **1.4 APPLICATIONS FOR PROGRESS PAYMENT**

- .1 Refer to CCDC 2, **GC 5.2**, and Section 00 80 00 - Supplementary Conditions.
- .2 Make applications for payment on account as specified as Work progresses.
- .3 Date applications for payment last day of agreed monthly payment period and ensure amount claimed is for value, proportionate to amount of Contract, of Work performed and Products delivered to Place of Work at that date.
- .4 Submit to Consultant, at least 10 working days before each application for payment, an invoice that includes a schedule of values for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of applications for payment.

#### **1.5 SCHEDULE OF VALUES**

- .1 Refer to CCDC 2, **GC 5.2**.
- .2 Provide schedule of values supported by evidence as Consultant may reasonably direct and when accepted by Consultant, be used as basis for applications for payment.
- .3 Include statement based on schedule of values with each application for payment.
- .4 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Consultant may reasonably require to establish value and delivery of products.

#### **1.6 PROGRESS PAYMENT**

- .1 Refer to CCDC 2, **GC 5.3**.
- .2 Consultant will issue to Owner, no later than 10 working days after receipt of a Proper Invoice, as defined per Section 00 80 00 - Supplementary Conditions, a certificate for payment in amount applied for or in such other amount as Consultant determines to be due. If Consultant amends application, Consultant will give notification to Owner and Contractor in writing giving reasons for amendment.

#### **1.7 SUBSTANTIAL PERFORMANCE OF WORK**

- .1 Refer to CCDC 2, **GC 5.4**, and Construction Act of Ontario.
- .2 Prepare and submit to Consultant comprehensive list of items to be completed or corrected and apply for a review by Consultant to establish Substantial Performance of Work or substantial performance of designated portion of Work when Work is substantially performed if permitted by lien legislation applicable to Place of Work [designated portion which Owner agrees to accept separately is substantially performed]. Failure to include items on list does not alter responsibility to complete Contract.
- .3 No later than 10 working days after receipt of list and application, Consultant will review Work to verify validity of application, and no later than 5 working days after completing review, will notify Contractor if Work or designated portion of Work is substantially performed.

- .4 Consultant: state date of Substantial Performance of Work or designated portion of Work in certificate.
- .5 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Consultant, establish reasonable date for finishing Work.

#### **1.8 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK**

- .1 Refer to CCDC 2, **GC 5.4**, and Construction Act of Ontario.
- .2 After issuance of certificate of Substantial Performance of Work:
  - .1 Submit application for payment of holdback amount.
  - .2 Submit sworn statement that accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of Work and for which Owner might in be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.
- .3 After receipt of application for payment and sworn statement, Consultant will issue certificate for payment of holdback amount.
- .4 Where holdback amount has not been placed in a separate holdback account, Owner shall, 10 working days prior to expiry of holdback period stipulated in lien legislation applicable to Place of Work, place holdback amount in bank account in joint names of Owner and Contractor.
- .5 Amount authorized by certificate for payment of holdback amount is due and payable on day following expiration of holdback period stipulated in lien legislation applicable to Place of Work. Where lien legislation does not exist or apply, holdback amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties. Owner may retain out of holdback amount sums required by law to satisfy liens against Work or, if permitted by lien legislation applicable to Place of Work, other third party monetary claims against Contractor which are enforceable against Owner.

#### **1.9 ANNUAL RELEASE OF HOLDBACK**

- .1 Refer to CCDC 2, **GC 5.4**, and Construction Act of Ontario.
- .2 Mandatory annual release of holdback governs Contract as per Construction Act of Ontario. Owner is required to publish a "notice" of annual release of holdback (Annual Notice) in the prescribed form no later than 14 days after the anniversary date on which the Contract was entered into. If there are no preserved or perfected liens after the lien period expires (60 days after the Annual Notice is published), the Owner must release the holdback within 14 days after the expiry of the lien period.
- .3 Ensure that Work is protected during the entire construction period and be responsible for correction of defects or Work not performed.

#### **1.10 FINAL PAYMENT**

- .1 Refer to CCDC 2, **GC 5.5**.
- .2 Submit application for final payment when Work is completed.
- .3 Consultant will, no later than 10 working days after receipt of application for final payment, review Work to verify validity of application. Consultant will give notification that application is valid or give reasons why it is not valid, no later than 5 working days after reviewing Work.

- .4      Consultant will issue final certificate for payment when application for final payment is found valid.

**END OF SECTION**

**1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE**

- .1 Particular requirements for inspection and testing to be carried out by testing and inspection agencies are specified under the various technical specification Sections of the Contract.

**2 APPOINTMENT AND PAYMENT**

- .1 Owner will appoint and pay for services of testing laboratory except as follows:
  - .1 Inspection and testing required by applicable laws, ordinances, rules, regulations or orders of authorities having jurisdiction.
  - .2 Inspection and testing performed exclusively for Contractor's convenience.
  - .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
  - .4 Mill tests and certificates of compliance.
  - .5 Tests specified to be carried out by Contractor under the supervision of Consultant.
- .2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Consultant to verify acceptability of corrected work.

**3 CONTRACTOR'S RESPONSIBILITIES**

- .1 To facilitate Owner's selection of testing services, Contractor shall obtain quotes from minimum of 3 testing companies, and make necessary arrangements with the selected testing company to organize the timing and procedures for testing and distribute results to Owner and Consultant.
- .2 Provide labour, equipment and facilities to:
  - .1 Provide access to Work for inspection and testing.
  - .2 Facilitate inspections and tests.
  - .3 Make good Work disturbed by inspection and test.
  - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.
- .3 Notify Consultant sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .4 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
  - .1 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Consultant.

**END OF SECTION**

## **1.1 ADMINISTRATIVE**

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Consultant.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting five (5) working days in advance of meeting date to Consultant.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within five (5) working days after meetings and transmit to meeting participants, affected parties not in attendance, and Consultant.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

## **1.2 CONSTRUCTION START-UP WORKSHOP**

- .1 Within ten (10) working days after award of Contract, or as otherwise specified in Owner's procurement documents, a meeting of project parties shall be called to discuss and resolve administrative procedures and responsibilities.
- .2 Key representatives of the Consultant team, Owner team, and Contractor team shall be in attendance. Attendees shall be authorized to make agreements on behalf of the team they represent.
- .3 Coordinate time and location of the meeting and notify the parties concerned a minimum of five (5) working days before the meeting.
- .4 Agenda to include:
  - .1 Appointment of official representative of participants in the Work.
  - .2 Health and safety responsibilities and strategy.
  - .3 Electrical and mechanical coordination (interference) drawings.
  - .4 Schedule of Work: in accordance with Construction Progress Schedules.
  - .5 Schedule of submission of shop drawings, samples, colour chips. Submit submittals as specified.
  - .6 Development and implementation strategies of Project six-week look-ahead schedules, trade cross-referenced and coordinated weekly work plans, trade tool-box meetings, and project flow visualizations to maximize production in realizing Owner objectives.
  - .7 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.
  - .8 Delivery schedule of specified equipment.
  - .9 Site security and fencing.
  - .10 Sustainable construction and material selection strategies.
  - .11 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
  - .12 As-built drawings and record documents.
  - .13 Maintenance manuals.
  - .14 Take-over procedures, acceptance, and warranties.

- .15 Monthly progress claims, administrative procedures, photographs, hold backs.
- .16 Appointment of inspection and testing agencies or firms.
- .17 Insurances, transcript of policies.
- .18 Commissioning requirements.
- .19 Demonstration and training requirements.

### **1.3 PROGRESS MEETINGS**

- .1 During the course of the Work prior to Substantial Performance of the Work, schedule progress meetings every two weeks.
- .2 The Contractor shall provide regular risk and safety reporting at the Project Progress Meetings, including updated Risks, safety statistics, trends and mitigative measures.
- .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 meetings.
  - .4 Review of the following plans and any updates:
    - .1 Health and Safety Plan,
    - .2 Quality Management Plan,
    - .3 Environmental Plan,
    - .4 Project Management Plan,
  - .5 Mould and moisture damage prevention – issues, concerns, remedies.
  - .6 Field observations, problems, conflicts.
  - .7 Problems that impede construction schedule.
  - .8 Review of off-site fabrication delivery schedules.
  - .9 Review material delivery dates/schedule.
  - .10 Corrective measures and procedures to regain construction schedule.
  - .11 Revisions to construction schedule.
  - .12 Progress, schedule, during subsequent period of the Work.
  - .13 Review submittal schedules: expedite as required.
  - .14 Maintenance of quality standards.
  - .15 Pending changes and substitutions.
  - .16 Review of Contemplated Change Orders (CCN), Change Orders (CO), Change Directives (CD), Supplemental Instructions (SI) for effect on construction schedule and on Contract Time.
  - .17 Review of status of as-built documents.
  - .18 Other business.

### **1.4 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 Contract Documents and as directed by the Consultant.

- .2 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.
  - .6 Schedule of submission of samples, colour chips, and items for Owner's consideration.
  - .7 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences, to Section 01 51 00 - Temporary Utilities and Section 01 52 00 - Construction Facilities.
  - .8 Requirements for notification for reviews. Allow a minimum of 48 hours' notice to Consultant for review of the Work.
  - .9 Requirements for inspections and tests, as applicable. Schedule and undertake inspections and tests in accordance with Section 01 45 00 - Quality Control.
  - .10 Delivery schedule of specified equipment.
  - .11 Special safety requirements and procedures.
- .3 The following shall be in attendance:
  - .1 Contractor.
  - .2 Subcontractors affected by the work for which the pre-installation meeting is being conducted.
  - .3 Consultant.
  - .4 Manufacturer's representatives.
  - .5 Inspection and testing company, as applicable.

## **1.5 PRE-TAKEOVER MEETING**

- .1 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 contemplated change orders, change orders, supplemental instructions, and change directives that may affect Substantial Performance of the Work.
  - .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 Other business.

## **1.6 POST-CONSTRUCTION MEETING**

- .1 Prior to application for completion of Contract, schedule a post-construction meeting. Four days prior to date for meeting, Consultant shall confirm a date for meeting based on evaluation of completion requirements.
- .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 Consultant to the Owner.
  - .4 Confirmation of completion of Contemplated Change Orders, Change Orders, Change Directives, 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 Consultant to the Owner.
  - .13 Handover of Contract completion insurance policy transcripts by Contractor.
  - .14 Submission of final application for payment.
  - .15 Review and finalize outstanding claims, pricing, and allowance amounts.
  - .16 Status of commissioning and training.
  - .17 Demobilization and the Place of the Work restoration.
  - .18 Other business.

## **1.7 SPECIAL MEETINGS**

- .1 Contractor, Owner and Consultant respectively reserve the right to require special meetings which may be held on short notice and at which attendance by Contractor and representatives of affected trades, Subcontractors and Suppliers is mandatory. Contractor shall keep detailed and accurate meeting notes and distribute copies promptly to all in attendance and those affected by agreements made at such meetings.



**END OF SECTION**

## **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract, as amended.
- .2 Project Management Institute (PMI Standards)
  - .1 A Guide to the Project Management Body of Knowledge (PMBOK Guide).
  - .2 Practice Standard for Scheduling.

## **1.2 DEFINITIONS**

- .1 Activity: Distinct, scheduled portion of work performed during course of a project.
- .2 Activity Duration: time in calendar units between start and finish of a scheduled activity. See also Duration.
- .3 Assumption: factor in planning process that is considered true, real, or certain without proof or demonstration.
- .4 Bar Chart (Gantt Chart): graphic display of schedule-related information.
- .5 In typical bar chart, schedule activities or work breakdown structure components are listed down left side of chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.
- .6 Baseline: approved version of a work product that can be changed only through formal change control procedures and is used as a basis for comparison.
- .7 Budget: approved estimate for a project or work breakdown structure component or schedule activity.
- .8 Cash Flow: projection of progress payment requests based on cash loaded construction schedule.
- .9 Change Control: process whereby modifications to documents, deliverables, or baselines associated with a project are identified, documented, approved, or rejected.
- .10 Completion Milestones: they are firstly Substantial Performance and secondly Final Certificate.
- .11 Constraint: scheduled limiting factor that effects execution of a project, program, portfolio, or process.
- .12 Contract: mutually binding agreement that obligates a seller to provide a specified product or service or result and obligates a buyer to pay for it.
- .13 Control: comparing actual performance with planned performance, analyzing variance, assessing trends, to effect process improvements, evaluating possible alternatives, and recommending appropriate corrective action as needed.
- .14 Corrective Action: intentional activity that realigns performance of project work with project management plan.
- .15 Critical Path: sequence of activities that represents longest path through a project, which determines shortest possible duration.
- .16 Critical Path Activity: activity on critical path in a project schedule.
- .17 Critical Path Method (CPM): method used to estimate minimum project duration and determine amount of scheduling flexibility on logical network of paths within schedule model.
- .18 Data Date: point in time when the status of the project is recorded.

- .19 Decomposition: technique used for dividing and subdividing project scope and project deliverables into smaller, more manageable parts.
- .20 Deliverable: unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, contract, or project.
- .21 Duration: total number of work periods (not including holidays or other non-working periods) required to complete a schedule activity or work breakdown structure component.
- .22 Usually expressed as workdays or work weeks.
- .23 Early Finish Date (EF): in Critical Path Method, earliest possible point in time when uncompleted portions of schedule activity can finish based on schedule network logic, data date, and schedule constraints.
- .24 Early finish dates can change as Project progresses and changes are made to Project plan.
- .25 Early Start Date (ES): in Critical Path Method, earliest possible point in time when uncompleted portions of a schedule activity can start based on schedule network logic, data date, and schedule constraints.
- .26 Early start dates can change as Project progresses and changes are made to Project Plan.
- .27 Execute: directing, managing, performing, and accomplishing project work; providing deliverables, and providing work performance information.
- .28 Finish Date: point in time associated with a schedule activity's completion.
- .29 Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.
- .30 Float: (also known as slack) amount of time a schedule activity can be delayed without delaying early start date of a successor or violating a schedule constraint.
- .31 This resource is available to both Consultant and Contractor.
- .32 Forecast: estimate or prediction of conditions and events in project future based on information and knowledge available at time of forecast.
- .33 Information is based on projects past performance and expected future performance, and includes information that could impact project in future, a such as estimate at completion and estimate to complete.
- .34 Gantt Chart: see Bar Chart.
- .35 Impact Analysis: schedule analysis technique that adds a modeled delay to an accepted construction schedule to determined possible outcome of that delay on project completion.
- .36 Imposed Date: a fixed date imposed on a schedule activity or schedule milestone, usually in form of a "start no earlier than" and "finish no later than" date.
- .37 Lag: amount of time whereby a successor activity is required to be delayed with respect to a predecessor activity.
- .38 Late Finish Date (LF): in critical path method, latest possible point in time when uncompleted portions of a schedule activity can finish based on schedule network logic, project completion date, and schedule constraints.
- .39 Late Start Date (LS): in critical path method, latest possible point in time when uncompleted portions of a schedule activity can start based on schedule network logic, project completion date, and schedule constraints.

- .40 Lead: amount of time whereby a successor activity can be advanced with respect to a predecessor activity.
- .41 Logic Diagram: see Project network diagram.
- .42 Logical Relationship: dependency between two activities or between an activity and a milestone.
- .43 Master Schedule: summary-level schedule that identifies major deliverable; work breakdowns structure components, and key schedule milestones.
- .44 Milestone: significant point or event in a project, program, or portfolio.
- .45 Monitor: collect project performance data with respect to a plan, procedure performance measures, and report and disseminate performance.
- .46 Network: see Project Schedule Network Diagram.
- .47 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
- .48 Project Control System: fully computerized system utilizing commercially available software packages.
- .49 Project Management: application of knowledge, skills, tools, and techniques, to project activities to meet project requirements.
- .50 Project Management Plan: approved document that describes how project will be executed, monitored, and controlled.
- .51 Primary uses of Project management plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines.
- .52 Project management plan may be summary or detailed.
- .53 Project Management Planning: development and maintenance of Project Plan.
- .54 Project Management Planning, Monitoring and Control System: overall system operated to enable monitoring of Project Work in relation to established milestones.
- .55 Project Schedule: planned dates for performing activities and planned dates for meeting milestones.
- .56 Project Schedule Network Diagram: graphical representation of logical relationships among project schedule activities.
- .57 Always drawn from left to right to reflect Project chronology.
- .58 Project Scope: work performed to deliver a product, service, or result with specified features and functions.
- .59 Quantified days duration: working days based on 5 day work week, discounting statutory holidays.
- .60 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on one or more project objectives.
- .61 Schedule: see Project Schedule.
- .62 Schedule Data: collection of information for describing and controlling schedule.
- .63 Scope: see Project Scope.
- .64 Start Date: point in time associated with activity's start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.

- .65 Work Breakdown Structure (WBS): hierarchical decomposition of total scope of work to be carried out by Contractor to accomplish project objectives and create the required deliverables.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Project Meeting:
  - .1 Meet with Owner and Consultant within 10 working days of Award of Contract date to establish Work requirements and approach to project construction operations.
  - .2 Participate in regular project progress meetings Consultant specifically intended to discuss update of detailed schedule and contract changes.
- .2 Scheduling:
  - .1 Ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made.
  - .2 Ensure project schedule efficiencies through monitoring of project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.
  - .3 Monitor sufficiently often so that causes of delays can immediately be identified and mitigated.
- .3 Project monitoring and reporting:
  - .1 Keep team aware of changes to schedule, and potential consequences as project progresses.
  - .2 Use narrative reports to provide advice on seriousness of challenges and measures to overcome them.
  - .3 Begin narrative reporting with statement on general status of Project followed by summarization of delays, potential problems, corrective measures and project status criticality.
- .4 Critical Path Method (CPM) Requirements:
  - .1 Ensure Master Plan and Detail Schedule are practical and remain within specified contract duration.
  - .2 Revise Master Schedule and Detail Schedule deemed impractical Consultant and resubmit for approval.
  - .3 Change to Contract Duration:
    - .1 Acceptance of Master Schedule and Detail Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract.
    - .2 Duration of Contract may only be changed through bilateral Agreement.
  - .4 Consider Master Schedule and Detail Schedule deemed practical by Consultant, showing Work completed in less than specified Contract duration, to have float.
  - .5 First Milestone on Master Schedule and Detail Schedule will identify start Milestone with an Early Start, "ES", constraint date equal to Award of Contract date.
  - .6 Calculate dates for completion of milestones from Plan and Schedule using specified time periods for Contract.
  - .7 Publication of Certificate of Substantial Completion with Late Finish, "LF", constraint equal to calculated date.

- .8 Calculations on updates such that if early finish of Interim Certificate falls later than specified Contract duration then float calculation to reflect negative float.
- .9 Delays to non-critical activities with float may not be basis for time extension.
- .10 Do not use float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times or imposed dates other than required by Contract.
- .11 Allow for adverse weather conditions normally anticipated and show in Master Plan and Detail Schedule.
  - .1 Specified Contract duration has been predicated assuming normal amount of adverse weather conditions.
- .12 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration.
  - .1 Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required.
- .13 Arrange participation on and off site of subcontractors and suppliers, as required by Consultant, for purpose of network planning, scheduling, updating and progress monitoring.
  - .1 Acceptance by Consultant of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.
- .14 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract

#### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit Project Control System to Consultant for planning, scheduling, monitoring and reporting of project progress.
- .3 Submit Project Control System to Consultant for approval.
- .4 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.
- .5 Submit letter ensuring that schedule has been prepared in coordination with major sub-contractors.
- .6 Submit impact analysis of schedule for changes that result in extension of contract duration.
  - .1 Include draft schedule update and report.
- .7 Submit Project planning, monitoring and control system data as part of initial schedule submission and monthly status reporting in following form.
  - .1 USB Drive files in original scheduling software as approved by Owner's Project Manager and Consultant containing schedule and cash flow information, labelled with data date, specific update, and person responsible for update.
  - .2 Master Schedule Bar Chart.
  - .3 Construction Detail Schedule Bar Chart.
  - .4 Listing of project activities including milestones and logical connectors, networks (sub-networks) from Project start to end. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.

- .5 Criticality report listing activities and milestones with zero and up to 5 days total float used as first sort for ready identification of critical or near critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.
- .6 Progress report in early start sequence, listing for each trade, activities due to start, underway, or finished within 2 months from monthly update date. List activity identification number, description and duration. Provide columns for entry of actual start and finish dates, duration remaining and remarks concerning action required.

## **1.5 QUALITY ASSURANCE**

- .1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to final completion, including commissioning.

## **1.6 WORK BREAKDOWN STRUCTURE**

- .1 Prepare construction Work Breakdown Structure (WBS) within 15 working days of Award of Contract date.
- .2 Develop WBS through at least five levels: project, stage, element, sub-element and work package.

## **1.7 MASTER SCHEDULE**

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.
- .2 Prepare comprehensive construction Master Schedule (CPM logic diagram) within 15 working days of finalizing Agreement to confirm validity or alternates of identified milestones.
  - .1 Master Schedule will be used as baseline.
    - .1 Revise baseline as conditions dictate and as required by Consultant.
    - .2 Consultant as Project progresses will review and return revised baseline within 10 working days.
- .3 Reconcile revisions to Master Schedule with previous baseline to provide continuous audit trail.
- .4 Initial and subsequent Master Schedule will include:
  - .1 USB Drive containing schedule and cash flow information, clearly labelled with data date, specific update, and person responsible for update.
  - .2 Bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.
  - .3 Network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.

## **1.8 DETAIL SCHEDULE**

- .1 Develop detailed Project Schedule derived from Master Schedule using Critical Path Method (CPM).
- .2 Provide detailed project schedule (CPM logic diagram) within 10 working days of Award of Contract date showing activity sequencing, interdependencies and duration estimates. Include listed activities as follows:
  - .1 Award.

- .2 Shop Drawings, Samples.
- .3 Permits.
- .4 Mobilization.
- .5 Excavation.
- .6 Cladding and Roofing.
- .7 Interior Architecture (Walls, Floors and Ceiling).
- .8 Commercial lift.
- .9 Plumbing.
- .10 Lighting.
- .11 Electrical.
- .12 Piping.
- .13 Controls.
- .14 Heating, Ventilating, and Air Conditioning.
- .15 Millwork.
- .16 Fire Systems.
- .17 Landscaping and Exterior Improvements.
- .18 Testing and Commissioning.
- .19 Supplied equipment long delivery items.
- .20 Owner-supplied or Tenant-supplied equipment required dates.
- .21 Other items not mentioned above forming part of the Work.
- .3 Detail CPM schedule to cover in detail minimum period of 3 months beginning from Award of Contract date with duration of each activity from 3 to 15 workdays each.
  - .1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.
  - .2 Detail activities completely and comprehensively throughout duration of project.
- .4 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Schedule.
- .5 Clearly show sequence and interdependence of construction activities and indicate:
  - .1 Start and completion of all items of Work, their major components, and interim milestone completion dates.
  - .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
    - .1 Time for submittals, resubmittals and review.
    - .2 Time for fabrication and delivery of manufactured products for Work.
    - .3 Interdependence of procurement and construction activities.
  - .3 Include sufficient detail to assure adequate planning and execution of Work. Activities generally range in duration from 3 to 15 workdays each.
- .6 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow co-ordination and control of project activities. Show continuous flow from left to right.
- .7 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout length of Project to form "Critical Path". Increased number of critical activities is seen as indication of increased risk.



- .8 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Consultant for review effects created by insertion of new Change Order.

#### **1.9 REVIEW OF CONSTRUCTION DETAIL SCHEDULE**

- .1 Allow minimum 5 workdays for review by Consultant of proposed construction Detail Schedule unless otherwise specified.
- .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to Consultant for review within maximum 5 workdays unless otherwise specified.
- .3 Promptly provide additional information to validate practicability of Detail Schedule as required by Consultant.
- .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

#### **1.10 COMPLIANCE WITH DETAIL SCHEDULE**

- .1 Comply with reviewed Detail Schedule.
- .2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after written receipt of approval by Consultant.
- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
  - .1 Corrective measures may include:
    - .1 Increase of personnel with more experience/qualifications on site for effected activities or work package.
    - .2 Increase in materials and equipment.
    - .3 Overtime work.
    - .4 Additional work shifts.
- .4 Submit to Consultant justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. As part of supporting evidence, include:
  - .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.
  - .2 Prepared schedule indicating how change will be incorporated into overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
  - .3 Other supporting evidence requested by Consultant.
  - .4 Do not assume approval of Contract extension prior to receipt of written approval from Consultant.
- .5 In event of Contract extension, display in Detail Schedule that scheduled float time available for work involved has been used in full without jeopardizing earned float.
  - .1 Consultant will determine and advise Contractor number of allowable days for extension of Contract based on project schedule updates for period in question, and other factual information.
  - .2 Construction delays affecting project schedule will not constitute justification for extension of contract completion date.

## **1.11 PROGRESS AND REPORTING**

- .1 On an ongoing basis, Detail Schedule on job site to show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Consultant at least once monthly to establish progress on each current activity shown on applicable networks.
- .2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.
- .3 Perform Detail Schedule update monthly with status dated (Data Date) on last working day of month. Update to reflect activities completed to date, activities in progress, logic and duration changes.
- .4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.
- .5 Submit to Consultant copies of updated Detail Schedule.
- .6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.
- .7 Submit monthly written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate potential delay. Include in report:
  - .1 Description of progress made.
  - .2 Pending items and status of: permits, shop drawings, change orders, possible time extensions.
  - .3 Status of Contract completion date and milestones.
  - .4 Current and anticipated problem areas, potential delays and corrective measures.
  - .5 Review of progress and status of Critical Path activities.

**END OF SECTION**

**1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract, as amended.

**2 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS**

- .1 Coordinate with the requirements of Section 01 33 00 - Submittal Procedures and Section 01 71 00 - Examination and Preparation.
- .2 Obtain from Consultant hard copy of the construction Drawings for the purpose of creating as-built drawings. Record information in electronic form, clearly identifying as-built deviations from the originally obtained construction Drawings. Drawings provided by the Consultant are copyright protected and may only be used for the purposes specified.
- .3 Clearly label each drawing as "AS-BUILT DRAWING". Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Record actual construction including:
  - .1 Measured depths of elements of foundation in relation to finish first floor datum.
  - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .3 Measured locations of pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.
  - .4 Field changes of dimension and detail.
  - .5 Changes made by Change Orders and Supplemental Instructions
  - .6 References to Shop Drawings, where Shop Drawings show more detail.
- .5 Do not use as-built drawings for construction purposes.
- .6 Keep an updated copy of As-Built Drawings on site at all times. Submit to Owner at completion of construction.

**3 PROGRESS PHOTOGRAPHS**

- .1 Arrange for periodic digital photography to document and provide a photographic record of the progress of the Work.
- .2 Identify each photograph by project name and date taken.
- .3 Submission: Submit .PNG format files in fine resolution monthly via project web site and by email to the Consultant monthly, and also at the following conditions: partition framing and services before concealment.
- .4 Do not use progress or any other Project photographs for promotional purposes without Owner's written consent.

**END OF SECTION**

## **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract, as amended.

## **1.2 DEFINITIONS**

- .1 Action Submittals: Written and graphic information and physical samples that require Consultant's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- .2 Informational Submittals: Written and graphic information and physical samples that do not require Consultant's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- .3 Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

## **1.3 ADMINISTRATIVE**

- .1 Submit specified submittals to Consultant for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time or for Product substitutions or other deviations from the Drawings and Specifications.
- .2 Submittals that are returned or rejected by Consultant because of insufficient review or coordination by Contractor will not be justification for a claim for extension of time.
- .3 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.
- .4 Do not proceed with Work affected by a submittal until review is complete.
- .5 Present Shop Drawings and samples in same units as used for the Contract Drawings. Where items or information is not produced in appropriate units, converted values are acceptable.
- .6 Review submittals, provide verified field measurements where applicable, and affix Contractor's review stamp prior to submission to Consultant. Contractor's review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the Work and Contract Documents.
- .7 Verify field measurements and that affected adjacent work is coordinated.
- .8 Submittals not meeting specified requirements will be returned with comments.
- .9 Reproduction of construction Drawings to serve as background for Shop Drawings is permitted. If construction Drawings are used for this purpose, remove references to Consultant.
- .10 Do not propose Substitutions or deviations from Contract Documents via Shop Drawings and sample submittals.

## **1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Indicate Products, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work.

- .2 Where Products attach or connect to other Products, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to Drawings, Specifications and other already reviewed Shop Drawings.
- .3 Accompany submittals with a transmittal information including:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification of each submittal item and quantity.
  - .5 Other pertinent data.
- .4 Shop Drawing submittals shall include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, date, and signature of Contractor's authorized representative responsible for Shop Drawing review, indicating that each Shop Drawing has been reviewed for compliance with Contract Documents and, where applicable, that field measurements have been verified.
  - .5 Details of appropriate portions of the Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationships to other parts of the Work.
- .5 Contractor must review Shop Drawings for as-built site conditions, coordination with other Work, site procedures, and conformance to the Drawings and Specifications. At no time shall the Contractor submit Shop Drawings to the Consultant without thorough review, nor rely on the Consultant for the review of Shop Drawings except for confirmation that they conform to the general design intent.
- .6 Product data submittals shall include Safety Data Sheets (SDS) and Technical Data Sheets (TDS) for specified Products.
- .7 Submit electronic copy of Shop Drawings where specified in the technical Specifications.
- .8 Submit electronic copy of Product data sheets or brochures where specified in the technical Specifications.
- .9 Where a submittal includes information not applicable to the Work, clearly identify applicable information and strike out non-applicable information.

- .10 Supplement standard information to include details applicable to Project.
- .11 If upon Consultant's review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of Work may proceed.
- .12 If upon Consultant's review significant errors or omissions are discovered, a noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.
- .13 Consultant's notations on submittals are intended to ensure compliance with Contract Documents and are not intended to constitute a change in the Work requiring change to the Contract Price or Contract Time. If Contractor considers any Consultant's notation to be a change in the Work, promptly notify Consultant in writing before proceeding with the Work.
- .14 Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the Work proceeds. When resubmitting, notify Consultant in writing of any revisions other than those requested by Consultant.

## **1.5 SAMPLES**

- .1 Submit samples for Consultant's review in triplicate where specified in the technical Specifications. Label samples as to origin, Project name, and intended use.
- .2 Deliver samples prepaid to address as identified by Consultant during project start-up meeting.
- .3 Notify Consultant in writing of any deviations in samples from requirements of Contract Documents.
- .4 Where a required colour, pattern or texture has not been specified, submit full range of available Products meeting other specified requirements.
- .5 Consultant selection from samples is not intended to change the Contract Price or Contract Time. If a selection would affect the Contract Price or Contract Time, notify Consultant in writing prior to proceeding with the Work.
- .6 Resubmit samples as required by Consultant to comply with Contract Documents.
- .7 Reviewed and accepted samples will establish the standard against which installed Work will be reviewed.

## **1.6 CONTRACTOR'S REVIEW OF SUBMITTALS**

- .1 Prior to transmitting submittal, review and approve submittal, and affix Contractor's signature and stamp to submittal.
- .2 Consultant will not review submittals that do not bear the Contractor's signature and in the case of mechanical and electrical, the Subcontractors' stamp and signature also. If it appears a review has not taken place, the submittal will be returned to the Contractor not reviewed.
- .3 By signing and submitting Shop Drawings, samples, and other specified submittals, the Contractor represents that they have approved, determined and verified dimensions, quantities, field dimensions, relations to existing work, coordination with work to be installed later, coordination with information on previously accepted Shop Drawings, samples, or other specified submittals and verification of compliance with requirements of Contract Documents.

- .4 In reviewing Shop Drawings, samples, and other specified submittals, the Consultant shall be entitled to rely upon Contractor's representation that information in submittals is correct and accurate.
- .5 Submittals that are returned or rejected because of insufficient Contractor review or coordination will not be justification for a claim for extension of Contract Time.

## **1.7 CONSULTANT'S REVIEW OF SUBMITTALS**

- .1 After receipt of submittal, Consultant will review it for conformance to Contract Documents and certify that this review has been performed by affixing Consultant's review stamp.
- .2 Review Time:
  - .1 Allow not less than 10 Working Days for processing and review of any one submittal except as noted below, and except when processing must be delayed for coordination with subsequent submittals. Consultant will advise Contractor promptly of such delay.
    - .1 Allow an additional 10 Working Days when sub-consultant or commissioning agent review is required, as determined by the Consultant.
    - .2 Identify those submittals for which review is urgently necessary.
    - .3 Allow 4 weeks after submission of all samples in Division 09, for the Consultant to select finishes and prepare a colour schedule.
  - .2 Review period begins on date of receipt of submittal by Consultant and extends to mailing date of return to Contractor.
- .3 Action Following Consultant's Review: Process submittals according to notations placed on them by Consultant.
  - .1 Reviewed:
    - .1 Proceed with fabrication, purchase, or both, of items in submittal, subject to the minor revisions or clarifications if any, included in the Consultant's review.
  - .2 Reviewed as Modified:
    - .1 Proceed with fabrication, purchase, or both, only after the original drawing has been corrected. Mechanical and Electrical Contractors to include corrected drawings in Maintenance and Operating Manuals.
  - .3 Resubmit:
    - .1 Submission is rejected, therefore fabrication and work indicated cannot proceed.
    - .2 Correct submission and resubmit.
  - .4 Not Reviewed:
    - .1 Submission was not reviewed for one of the following reasons:
      - .1 Contractor's stamp was not found on submission.
      - .2 In the Consultant's opinion, review was not necessary.
- .4 Limitations of Consultant's Review:
  - .1 The Consultant's review is for conformity to the intent of the Contract Documents and for general arrangement only. The Consultant's review does not relieve the Contractor of the responsibility for errors or omissions in Shop Drawings or other submittals, or for meeting all requirements of the Contract Documents, unless the Owner expressly accepts a deviation from the Contract Documents by means of a properly authorized and issued Change Order.

- .2 Consultant's review does not authorize changes in Contract Price or Contract Time unless so stated in a separate Proposed Change or Change Directive.
- .3 If the Contractor feels the Shop Drawing has changed the Contract Price or Contract Time, they must notify the Consultant within 5 Working Days from date of Consultant's transmittal otherwise it will be assumed no change in Contract Price or Contract Time will be considered.
- .4 Review of Shop Drawings is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the reviewer approves the detail design inherent in the Shop Drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of their responsibility for errors or omissions in the Shop Drawings or of their responsibility for meeting all requirements of the Contract Documents. The Contractor is 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.
- .5 After the Consultant's review of a submittal or resubmittal, changes will not be considered unless accompanied by an explanation acceptable to the Consultant concerning reason substitution is necessary.

**END OF SECTION**



## 1.1 SUMMARY

- .1 The requirements of this section are in general conformance with recommended *Professional Engineering Practice*, published by Professional Engineers Ontario (PEO) with regards to duties of professionals appointed during construction period.
- .2 Delegated Design Submittals shall account for professional engineering responsibility for design, review and acceptance of components of Work forming a part of permanent Work in accordance with Ontario Building Code (OBC) and that has been assigned to a design entity other than Consultant including, but not limited to, the following:
  - .1 Design requiring structural analysis of load bearing components and connections.
  - .2 Design requiring compliance with fire safety regulations.
  - .3 Design requiring compliance with life or health safety regulations.
- .3 Delegated Design Submittals are not required for components of Work requiring engineering for temporary Work (e.g., crane hoisting, engineered lifts, falsework, shoring, concrete formwork, etc.) that would normally form a part of Contractor's scope of Work.
- .4 The requirements of this Section do not diminish responsibilities of Consultant's role as Registered Professional of Record; submittals will be used by Consultant to establish that Work is substantially performed in accordance with the Building Code.
- .5 The delegated design engineer must be a Professional Engineer (P.Eng.) licensed to practice in the jurisdiction of the Place of the Work and must provide proof of professional liability insurance in the form of a Certificate of Insurance, which must be maintained as recommended by Professional Engineers Ontario.
- .6 Provide submittals for Delegated Design services or certifications by a professional engineer (P.Eng.), whose signature and seal shall appear on all drawings, calculations, specifications, certifications, *Shop Drawings*, field review reports and other submittals prepared by them.
- .7 Shop Drawings and other submittals related to the Work, designed or certified by the professional responsible for the Delegated Design, if prepared by others, shall bear such professional's written approval when submitted.
- .8 The *Consultant* will review Delegated Design submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the *Contract Documents*.
- .9 Where the supply and installation of a guardrail system is called for, include for all support steel, miscellaneous metals, glazing, clips, fasteners, panels, engineering of complete assembly and submit Shop Drawings showing same. Such shop drawings to be sealed by an engineer experienced in such work and licensed to practice in the jurisdiction of the Place of the Work.
- .10 Where glass is likely to be subjected to human impact it shall comply with applicable specified safety glass and Building Code requirements, including design to withstand lateral guard loads where the glass in question is not protected by stand-alone guards. Include for all support steel, miscellaneous metals, glazing, clips, curtain wall or window frame, fasteners, panels, engineering of complete assembly and submission of Shop Drawings showing same. Such shop drawings to be sealed by an engineer experienced in such work and licensed to practice in the jurisdiction of the Place of the Work.

## 1.2 DELEGATED DESIGN

- .1 Performance and Design Criteria: Provide products and systems complying with specific performance and design criteria indicated where professional design services or certifications by a design professional are specifically required of the Contractor by Contract Documents.
- .2 If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Consultant.
- .3 Where Building Code requirements pertain to an assembly, then that entire assembly and all of its components must be designed to meet the Building Code, with the assembly design bearing the seal and signature of the delegated design Professional Engineer (P.Eng.).
- .4 Design for post-disaster importance factors as per OBC, and relevant OBC commentaries. Refer to structural design Drawings, PROJECT DESIGN DATA TABLE, and Section 01 11 00 Summary of Work, item 1.7 POST DISASTER BUILDING, for load data and other information.
- .5 Delegated design will be required for elements designed by a specialty professional, loads as determined in accordance with the OBC, which may include but are not necessarily limited to the following:
  - .1 Elements that require specialized fabrication equipment or a proprietary fabrication process not usually available at job site (e.g., guardrails, handrails, open web steel joists, noise and vibration isolation devices, etc.).
  - .2 Elements requiring engineering not normally part of scope of services performed by Consultant.
  - .3 Elements identified in the Specifications or Drawings as requiring engineered shop drawings, and delegated design engineering requirements specified by the following:
    - .1 Section 04 22 00 - Unit Masonry.
    - .2 Section 05 41 00 - Structural Metal Stud Framing.
    - .3 Section 05 50 00 - Metal Fabrications.
    - .4 Section 05 51 00 - Metal Stairs and Railings.
    - .5 Section 07 42 42 - Aluminum Composite Panels.
    - .6 Section 07 46 19 - Preformed Metal Cladding.
    - .7 Section 07 61 13 - Standing Seam Sheet Metal Roofing.
    - .8 Section 07 84 00 - Firestopping and Smoke Seals.
    - .9 Section 08 36 40 - Glazed Overhead Doors.
    - .10 Section 08 44 13 - Glazed Aluminum Framing Systems.
    - .11 Section 09 22 00 - Non-Structural Metal Framing.
    - .12 Section 09 51 13 - Acoustical Panel Ceilings.
    - .13 Section 09 51 14 - Acoustic Ceiling Baffles.
    - .14 Section 10 75 00 - Flagpoles
    - .15 Section 13 34 19 - Pre-engineered Metal Building RFQ.
    - .16 Other Sections requiring engineered Shop Drawings.

**1.3 LETTER OF COMMITMENT**

- .1 Submit a signed and sealed Letter of Commitment on company letterhead addressed to Consultant in accordance with format in Appendix A attached to the end of this Section prior to starting Work requiring design and seal of a professional engineer.

**1.4 LETTER OF COMPLIANCE**

- .1 Submit a signed and sealed Letter of Compliance on company letterhead addressed to Consultant in accordance with format in Appendix B attached to the end of this Section on completion of Work requiring design and seal of a professional engineer.

**1.5 IMPLEMENTATION**

- .1 Include summary of Work described in relevant technical specification section as a part of the required Letter of Commitment.
- .2 Prepare required submittals and present to Consultant within sufficient time to allow for Consultant's detailed review and acceptance.

**END OF SECTION**

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## APPENDIX A

### LETTER OF COMMITMENT

Submit a signed and sealed letter of commitment on company letterhead in the form as follows:

[Date]

[Consultant]

[Consultant's Address]

Attention: [Consultant's Registered Professional of Record]

Re: Letter of Commitment for Delegated Design of [System of Component of Work]  
North Paris Fire Station  
21 Ann Wilson Way, Paris, ON  
[Date of applicable tender package]

As the retained registered professional engineer for design and field review of the above named component of Work and project, I hereby give assurance I am qualified to perform the following Work as required by Contract Documents:

1. [List appropriate design services for System or Component of Work];
2. Preparation of shop and erection documents;
3. Review fabrication of [structural] [fire rated] [life and health safety] components;
4. Review erection of [structural] [fire rated] [life and health safety] components.
5. [Modify list to suit System of Component of Work.]

I hereby give assurance that I will be responsible for above noted Work as described in Section [?????] – [Name of Section] of Project Manual, including requirements of addenda, change orders and change directives.

I also undertake to be responsible for field review of fabrication and erection of [structural] [fire rated] [life and health safety] components as required to ascertain substantial compliance with the Ontario Building Code and Contract Documents.

I will notify you in writing if my responsibility is terminated at any time during the course of Work covered by this Letter of Commitment.

### Retained Professional Engineer

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

(Apply seal)

---

**APPENDIX B**

LETTER OF COMPLIANCE

[Date]

[Consultant]

[Consultant's Address]

Attention: [Consultant's Registered Professional of Record]

Re: Letter of Compliance for Delegated Design of [System of Component of Work]  
North Paris Fire Station  
21 Ann Wilson Way, Paris, ON  
[Date of applicable tender package]

I hereby give assurance that I have fulfilled my obligations for field review as outlined by previously submitted Letter of Commitment.

I hereby give assurance that aspects of [structural] [life and health safety] Work as defined by previously submitted Letter of Commitment substantially comply with Contract Documents and Building Code.

**Retained Professional Engineer**

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

(Apply seal)

## **1.1 REFERENCES**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .3 Province of Ontario
  - .1 Occupational Health and Safety Act, Regulations, and amendments.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site specific safety hazard assessment.
  - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Consultant and authority having jurisdiction, weekly.
- .4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS SDS - Safety Data Sheets.
- .7 Consultant will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Consultant within 7 days after receipt of comments from Consultant.
- .8 Consultant's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Consultant
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

## **1.3 FILING OF NOTICE**

- .1 File Notification of Project with Provincial authorities prior to beginning of Work.
  - .1 According to Section 6 of the Regulation for Construction Projects (O. Reg. 213/91) constructors are required to notify the Ministry of Labour before construction begins of any project meeting any of the requirements applicable to this section.
- .2 Registration of Constructors and Employers Engaged in Construction:
  - .1 According to Section 5 of the Regulation for Construction Projects (O. Reg. 213/91), before beginning work at a project every constructor and employer engaged in construction has to complete an approved registration form.

- .2 This form does not have to be submitted to the Ministry of Labour, but it must be at the project while the employer is working there.

.3 Notice of Trench Work:

- .1 Notify the Ministry of Labour, before work is begun at a construction project, if the project includes work on a trench more than 1.2 metres deep into which a worker may enter.

**1.4 SAFETY ASSESSMENT**

- .1 Perform site specific safety hazard assessment related to project.

**1.5 MEETINGS**

- .1 Schedule and administer Health and Safety meeting with Owner and Consultant prior to commencement of Work.

**1.6 GENERAL REQUIREMENTS**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

**1.7 RESPONSIBILITY**

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

**1.8 COMPLIANCE REQUIREMENTS**

- .1 Comply with Occupational Health and Safety Act of Ontario.

**1.9 UNFORESEEN HAZARDS**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Consultant verbally and in writing.

**1.10 CONSTRUCTOR**

- .1 Responsibility for Work Site Safety – The Contractor Is "Constructor":
  - .1 The Contractor shall, for the purposes of the Occupational Health and Safety Act (Ontario), and for the duration of the Work of this Contract:
    - .1 Be the "Constructor" for the "Work Site", and
    - .2 Meet requirements of the Occupational Health and Safety Act and regulations made under the Act, Workplace Safety and Insurance Board requirements, Fire Code legislation, Workplace Safety and Insurance

Act, and all other applicable laws, ordinances and by laws that govern workplace safety.

- .2 The Contractor shall direct all sub-subcontractors, Other Contractors, employees, Suppliers, workers and any other persons at the "Work Site" on safety related matters, to the extent required to fulfill its "Constructor" responsibilities pursuant to the Act, regardless of:
  - .1 Whether or not any contractual relationship exists between the Contractor and any of these entities, and
  - .2 Whether or not such entities have been specifically identified in this Contract.
- .3 The Contractor shall employ or engage the services of a safety officer who has one of the recognized safety certifications or designations listed in the "*Guide to OH&S Certifications & Designations*". The safety officer shall oversee site safety on behalf of the Contractor, and shall have the authority to stop dangerous work, direct the correction of safety deficiencies, offer site-specific safety training, and manage the Contractor's safety procedures for the duration of the Contract.

#### **1.11 POSTING OF DOCUMENTS**

- .1 Ensure applicable items, articles, notices, and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Consultant.

#### **1.12 CORRECTION OF NON-COMPLIANCE**

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Consultant.
- .2 Provide Consultant with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Consultant may stop Work if non-compliance of health and safety regulations is not corrected.

#### **1.13 BLASTING**

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Consultant.

#### **1.14 POWDER ACTUATED DEVICES**

- .1 Use powder actuated devices only after receipt of written permission from Consultant.

#### **1.15 WORK STOPPAGE**

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

#### **1.16 FIRE SAFETY**

- .1 The Contractor is responsible for on-site fire safety during the project, and shall establish policies and procedures sufficient to manage risk and safeguard the Work as required to prevent fires.
- .2 A Firewatch is a person assigned to observe ongoing hot work (welding, use of torches, etc.) to identify and react to hazards. A Firewatch is necessary at any time where hot



- Work (e.g., welding, etc.) is performed in locations where a fire greater than a minor one might develop.
- .3 Before hot work begins, written permission, like a hot work permit, must be issued by the Contractor.
  - .4 Inspect the work area for any sources of fuel, such as trash, rags and flammable materials and liquids. This applies to lower decks or levels where sparks or slag could fall.
  - .5 Some of the responsibilities of a Firewatch include:
    - .1 Having fire extinguishing equipment readily available;
    - .2 Know how to sound an alarm in the event of a fire;
    - .3 Monitor for fires in all exposed areas, including lower decks or levels;
    - .4 Attempt to extinguish the fire only within the capacity of available equipment, if not sound the alarm;
    - .5 Monitor hot work area for at least half an hour after hot work operations stop.
  - .6 A Firewatch can have no other duties during hot work. Continuous surveillance must be maintained throughout the course of the hot work, including a minimum 2-hour cool down period after hot work concludes, or longer if determined by the Contractor's health and safety risk assessment.
  - .7 Fire Separations:
    - .1 Ensure that fire separations are installed to maintain total integrity and that they are not breached by Work following their installation.
    - .2 Replace fire separations which have suffered a lessening of their required rating during construction.
  - .8 Fire watch and Evacuations:
    - .1 Hot Work: means activities involving open combustion including, but not limited to use of torches, fires and welding equipment.
    - .2 Maintain a 2-hour fire watch following completion of Hot Work day and at all times during Hot Work.
      - .1 Scan hot work locations prior to leaving site at end of each workday using a spot thermal camera; e.g., similar to FLIR TG165 Spot Thermal Camera, by FLIR.
    - .3 Maintain a system of evacuation alarms, strategically located throughout the construction site and capable of being heard by workers wearing hearing protection in high noise areas of the workplace.
    - .4 Provide for multiple means of egress from the construction areas for workers during all phases of construction and brief workers periodically on such escape routes.

#### **1.17 REPORTING FIRES**

- .1 Post a notice indicating the location of the nearest fire alarm box and telephone, including the emergency telephone number.
- .2 Report immediately all fire incident to the Fire Department.
- .3 The person reporting the fire shall ensure that the Fire Department is adequately directed to the scene of the fire.

- .4 Give location of fire, name or number of building and be prepared to verify the civic address, or other definitive location.

**END OF SECTION**

**1.1 FIRES**

- .1 Fires and burning of rubbish on site not permitted.

**1.2 DRAINAGE**

- .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .2 Do not pump water containing suspended materials into waterways or drainage systems. Migration to water retention pond is allowed.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

**1.3 SITE CLEARING AND PLANT PROTECTION**

- .1 Protect trees and plants on site and adjacent properties where indicated on Drawings and in Specifications.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by Consultant.

**1.4 POLLUTION CONTROL**

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area, by providing temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

**1.5 EROSION AND SEDIMENT CONTROL**

- .1 Refer to the civil design Drawings.

**END OF SECTION**

## 1.1 REFERENCES AND CODES

- .1 The following establishes the minimum requirements of the Contract:
  - .1 Ontario Building Code.
  - .2 Contract Documents.
  - .3 Specified standards, Codes, and referenced documents found in Contract Documents.
  - .4 Orders and directions from authorities having jurisdiction.
- .2 Province of Ontario - Work shall comply with the following, including errata and amendments:
  - .1 Perform Work in accordance with the laws and regulations of the Province of Ontario applicable to the Work, and to the direction of the authorities having jurisdiction.
  - .2 Ontarians with Disabilities Act, 2005, S.O. 2005, c. 11.
  - .3 Occupational Health and Safety Act.
  - .4 Occupational Health and Safety Act, Ontario Regulation 213/91 Construction Projects.
  - .5 Environmental Protection Act, R.S.O. 1990, c. E.19.
  - .6 Ontario Construction Act, R.S.O. 1990, c. C.30.
  - .7 Ontario Employment Standards Act, 2000, S.O. 2000, c. 41 and Regulations under this Act.
  - .8 Other laws and regulations applicable to the Work.
- .3 Regions and Municipalities:
  - .1 Perform Work in accordance with local by-laws, regulations and ordinances, and to the direction of the authorities having jurisdiction.

## 1.2 FLAME-SPREAD RATINGS

- .1 The interior wall and ceiling finishes throughout the building shall conform to the flame spread ratings of OBC Subsection 3.1.13.
- .2 Flame-spread rating and smoke developed classification for all finishes shall be determined under CAN/ULC-S102 or CAN/ULC-S102.2 as appropriate, or in accordance with OBC Supplementary Standard SB-2.
- .3 The flame-spread ratings for interior finishes are summarized as follows:

Occupancy, Location or Element	Maximum Permitted Flame-Spread Rating for Wall Surfaces	Maximum Permitted Flame-Spread Rating for Ceiling Surfaces
Exit stairways and exit corridors <sup>1</sup>	25	25
Public corridors and corridors not within suites	150	150
Elevator cars	75	75
Elevator vestibules	25	25

Occupancy, Location or Element	Maximum Permitted Flame-Spread Rating for Wall Surfaces	Maximum Permitted Flame-Spread Rating for Ceiling Surfaces
Services spaces, service shafts, service rooms	25	25
Doors (including overhead garage doors)	200	NA
Plumbing fixtures	200	200
Other locations and other elements	150	150

<sup>1</sup> The flame spread rating for exits applies to any surface in the exit that would be exposed by cutting through the material in any direction, excluding doors.

- .4 Combustible plumbing fixtures, including shower and tub caps and surrounds shall be fabricated of material having a flame-spread rating not exceeding 200.
- .5 If combustible interior wall and ceiling finishes are used in the building, they shall not be more than 25 mm thick, and flame-spread restrictions apply to any surface that would be exposed by cutting.
- .6 The maximum allowable flame-spread rating of walls and up to 10% of a ceiling area within a sprinklered floor area, excluding exits and vertical service spaces, is 150; the remainder of the ceiling area shall have a flame spread rating not exceeding 25.

### 1.3 BUILDING SMOKING ENVIRONMENT

- .1 No smoking of any kind is permitted on or immediately adjacent to the Place of the Work, including electronic cigarettes or devices.
- .2 Smoking restrictions apply to all persons at all times without exception.

### 1.4 WORKPLACE SAFETY AND INSURANCE

- .1 Comply with the Ontario Workplace Safety and Insurance Act, 1997, S.O. 1997, c. 16, Schedule A and Regulations under this Act, including errata and amendments.

### 1.5 LABOUR STANDARDS

- .1 Comply with the Ontario Employment Standards Act, 2000, S.O. 2000, c. 41 and Regulations under this Act, including errata and amendments.

### 1.6 HARASSMENT POLICY

- .1 Develop workplace harassment and offensive language policy and procedures. Submit to Consultant within 15 days of award of Contract.

### 1.7 BUILDING CODE

- .1 Comply with the Ontario Building Code Act, 1992, S.O. 1992, c. 23, including errata and amendments, and Regulations under this Act, including but not necessarily limited to O. Reg. 332/12 BUILDING CODE, including errata and amendments.

**1.8 EMPLOYMENT INSURANCE**

- .1 Comply with the provisions of the Employment Insurance Act (S.C. 1996, c. 23) and Regulations (SOR /96-332) of Canada, including errata and amendments.

**1.9 ACCESSIBILITY FOR ONTARIANS WITH DISABILITIES ACT (AODA)**

- .1 Comply with the provisions of Accessibility for Ontarians with Disabilities Act, 2005, S.O. 2005, CHAPTER 11; amended: 2016, c. 5, Sched. 1; and O. Reg. 191/11: INTEGRATED ACCESSIBILITY STANDARDS.

**1.10 ONTARIO HUMAN RIGHTS CODE (OHRC)**

- .1 Comply with the provisions of the Ontario Human Rights Code R.S.O. 1990, CHAPTER H.19; amended 2018, c. 3, Sched. 5, s. 27.

**END OF SECTION**

## 1.1 ASSOCIATIONS AND ORGANIZATIONS

- .1 Refer to the Ontario Building Code: abbreviations and acronyms found in that document apply to the Specifications.
- .2 The following are typical abbreviations and acronyms frequently used in the Specifications when referencing associations and organizations.
  - .3 AA - Aluminum Association, 900 19th Street N.W., Washington, D.C., U.S.A. 20006 URL <http://www.aluminum.org>.
  - .4 ACEC Association of Consulting Engineers of Canada, 130 Albert Street, Suite 616, Ottawa, ON. K1P 5G4 URL <http://www.acec.ca>.
  - .5 AHA - American Hardboard Association, 1210W Northwest Hwy., Palatine, Illinois, U.S.A. 60067 URL: <http://www.hardboard.org>
  - .6 AITC - American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, Colorado, U.S.A. 80112 URL <http://www.aitc-glulam.org>.
  - .7 AMCA - Air Movement and Control Association Inc., 30 West University Drive, Arlington Heights, Illinois, U.S.A. 60004-1893 URL <http://www.amca.org>.
  - .8 ANSI - American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, New York, U.S.A. 10036 URL <http://www.ansi.org>.
  - .9 APA - The Engineered Wood Association, P.O. Box 11700, Tacoma, Washington, U.S.A. 98411-0700 URL <http://www.apawood.org>.
  - .10 ARI - Air Conditioning and Refrigeration Institute, 4100 N Fairfax Drive, Suite 200, Arlington, Virginia, U.S.A. 22203 URL <http://www.ari.org>.
  - .11 ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, Georgia, U.S.A. 30329 URL <http://www.ashrae.org>.
  - .12 ASME - American Society of Mechanical Engineers, ASME Headquarters, 3 Park Avenue, New York, New York, U.S.A. 10016-5990 URL <http://www.asme.org>
  - .13 ISAP - International Society for Asphalt Paving, 400 Selby Avenue, Suite 1, St. Paul, MN 55102 U.S.A. URL <http://www.asphalt.org>.
  - .14 ASTM - American Society for Testing and Materials, 100 Barr Harbor Drive West, Conshohocken, Pennsylvania 19428-2959 URL <http://www.astm.org>.
  - .15 AWMAC - Architectural Woodwork Manufacturers Association of Canada, 516-4 Street West, High River, Alberta T1V 1B6 URL <http://www.awmac.com>.
  - .16 AWPA - American Wire Producer's Association, 801 N Fairfax Street, Suite 211, Alexandria, VA U.S.A. 22314-1757 URL <http://www.awpa.org>.
  - .17 AWPA - American Wood Preservers' Association, P.O. Box 5690, Granbury Texas, U.S.A. 76049-0690 URL <http://www.awpa.com>.
  - .18 AWS - American Welding Society, 550 N.W. LeJeune Road, Miami, Florida U.S.A. 33126 URL <http://www.amweld.org>.
  - .19 CCA Canadian Construction Association, 75 Albert St., Suite 400 Ottawa, Ontario, K1P 5E7 URL <http://www.cca-acc.com>.
  - .20 CCDC Canadian Construction Documents Committee, Refer to ACEC, CCA, CSC or RAIC.
  - .21 CGA - Canadian Gas Association, 20 Eglinton Avenue West, Suite 1305, Toronto, Ontario M4R 1K8 URL <http://www.cga.ca>.

- .22 CGSB - Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 0S5 URL <http://w3.pwgsc.gc.ca/cgsb>.
- .23 CISC - Canadian Institute of Steel Construction, 201 Consumers Road, Suite 300, Willowdale, Ontario M2J 4G8 URL <http://www.cisc-icca.ca>.
- .24 CLA - Canadian Lumbermen's Association, 27 Goulburn Avenue, Ottawa, Ontario, K1N 8C7 URL <http://www.cla-ca.ca>.
- .25 CNLA - Canadian Nursery Landscape Association, RR #4, Stn. Main, 7856 Fifth Street, Milton, Ontario. L9T 2X8 URL <http://www.canadanursery.com>.
- .26 CRCA - Canadian Roofing Contractors Association, 155 Queen Street, Suite 1300, Ottawa, Ontario K1P 6L1 URL <http://www.roofingcanada.com>.
- .27 CSA - Canadian Standards Association International, 178 Rexdale Blvd., Toronto, Ontario M9W 1R3 URL <http://www.csa-international.org>.
- .28 CSC - Construction Specifications Canada, 120 Carlton Street, Suite 312, Toronto, Ontario M5A 4K2 URL <http://www.csc-dcc.ca>.
- .29 CSDMA - Canadian Steel Door Manufacturers Association, One Yonge Street, Suite 1801, Toronto, Ontario M5E 1W7.
- .30 CSPI - Corrugated Steel Pipe Institute, 652 Bishop Street N, Unit 2A, Cambridge, Ontario N3H 4V6 URL <http://www.cspi.ca>.
- .31 CSSBI - Canadian Sheet Steel Building Institute, 652 Bishop St. N., Unit 2A, Cambridge, Ontario N3H 4V6 URL <http://www.cssbi.ca>.
- .32 CUFCA Canadian Urethane Foam Contractor's Association, Box 3214, Winnipeg, Manitoba, R3C 4E7 URL <http://www.cufca.ca>.
- .33 CWC - Canadian Wood Council, 1400 Blair Place, Suite 210, Ottawa, Ontario K1J 9B8 URL <http://www.cwc.ca>.
- .34 EC - Environment Canada, Conservation and Protection, Inquiry Centre, 351 St. Joseph Blvd, Hull, Québec KIA 0H3 URL <http://www.ec.gc.ca>.
- .35 EFC - Electro Federation of Canada, 5800 Explorer Drive, Suite 200, Mississauga, Ontario L4W 5K9 URL <http://www.electrofed.com>
- .36 EIMA EIFS Industry Manufacturer's Association, 3000 Corporate Center Drive, Suite 270, Morrow, Georgia U.S.A. 30260 URL <http://www.eima.com>
- .37 FCC - Fire Commissioner of Canada, Place du Portage, Phase II, 165 rue Hotel de Ville, Hull, Quebec K1A 0J2 <http://info.load-otea.hrdc-drhc.gc.ca/fire-prevention/standards/commissioner.shtml>.
- .38 IEEE - Institute of Electrical and Electronics Engineers, IEE Corporate Office, 3 Park Avenue, 17th Floor, New York, New York U.S.A. 10016-5997 URL <http://www.ieee.org>.
- .39 MPI - The Master Painters Institute, 4090 Graveley Street, Burnaby, BC V5C 3T6 URL <http://www.paintinfo.com>.
- .40 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, Virginia U.S.A. 22180-4602 URL <http://www.mss-hq.com>.
- .41 NAAMM - National Association of Architectural Metal Manufacturers, 8 South Michigan Avenue, Suite 1000, Chicago, Illinois U.S.A. 60603 URL <http://www.naamm.org>.



- .42 NABA - National Air Barrier Association, PO Box 2747, Winnipeg, Manitoba R3C 4E7 URL <http://www.naba.ca>.
- .43 NBC - National Building Code of Canada 2015, including errata and amendments.
- .44 NEMA - National Electrical Manufacturers Association, 1300 N. 17th Street, Suite 1847, Rosslyn, Virginia 22209 URL <http://www.nema.org>
- .45 NFPA - National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101 Quincy, Massachusetts, U.S.A. 02269-9101 URL <http://www.nfpa.org>
- .46 NFSA - National Fire Sprinkler Association, P.O. Box 1000, Patterson, New York, U.S.A. 12563 URL <http://www.nfsa.org>.
- .47 NHLA - National Hardwood Lumber Association, 6830 Raleigh-La Grange Road, Memphis, TN, U.S.A 38184-0518 URL <http://www.natlhardwood.org>
- .48 NLGA - National Lumber Grades Authority, 406-First Capital Place, 960 Quayside Drive, New Westminster, B.C. V3M 6G2.
- .49 NRC - National Research Council, Building M-58, 1200 Montreal Road, Ottawa, Ontario K1A 0R6 URL <http://www.nrc.gc.ca>.
- .50 NSPE - National Society of Professional Engineers, 1420 King Street, Alexandria, VA U.S.A. 22314-2794 URL <http://www.nspe.org>.
- .51 OBC - Ontario Building Code, most recent published edition, plus all published amendments.
- .52 PCI - Prestressed Concrete Institute, 209 W. Jackson Blvd., Suite 500, Chicago, Illinois, U.S.A. 60606-6938 URL <http://www.pci.org>.
- .53 PEI - Porcelain Enamel Institute, PO Box 920220, Norcross, GA U.S.A. 30010, URL <http://www.porecelainenamel.com>.
- .54 QPL - Qualification Program List, c/o Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 URL <http://www.pwgsc.gc.ca/cgsb>.
- .55 RAIC Royal Architectural Institute of Canada, 55 Murray Street, Suite 330, Ottawa, Ontario, K1N 5M3 URL <http://www.raic.org>.
- .56 SCC - Standards Council of Canada, 270 Albert Street, Suite 2000, Ottawa, Ontario K1P 6N7 URL <http://www.scc.ca>.
- .57 SSPC - The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, Pennsylvania 15222-4656 URL <http://www.sspc.org>.
- .58 TPI - Truss Plate Institute, 583 D'Onofrio Drive, Suite 200, Madison, WI, U.S.A. 53719 URL <http://www.tpinst.org>.
- .59 TTMAC - Terrazzo, Tile and Marble Association of Canada, 30 Capston Gate, Unit 5 Concord, Ontario L4K 3E8 URL <http://www.ttmac.com>.
- .60 UL - Underwriters' Laboratories, 333 Pfingsten Road, Northbrook, Illinois, U.S.A. 60062-2096 URL <http://www.ul.com>.
- .61 ULC - Underwriters' Laboratories of Canada, 7 Crouse Road, Toronto, Ontario M1R 3A9 URL <http://www.ulc.ca>.

**END OF SECTION**

## **1.1 REFERENCE STANDARDS**

- .1 "Reference standards" means consensus standards, trade association standards, guides, and other publications expressly referenced in Contract Documents.
- .2 Where an edition or version date is not specified, referenced standards shall be deemed to be the latest published edition or revision issued by the publisher at the time of bid closing.
- .3 Reference standards establish minimum requirements. If Contract Documents call for requirements that differ from a referenced standard, the more stringent requirements shall govern.
- .4 If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Consultant for clarification.
- .5 Within the Specifications, reference may be made to the specific standards writing, testing, or certification organizations by their acronyms or initialisms:
  - .1 Refer to Section 01 42 00 – References.
  - .2 Notify the Consultant immediately by email if any acronym or initialism used in the technical Specifications is unclear or unknown.

## **1.2 TERMS AND DEFINITIONS**

- .1 Corrective Actions: Steps that are taken to remove the causes of an existing non-conformity or undesirable situation. The Corrective Action Process is designed to prevent the recurrence of non-conformities or undesirable situations. It tries to make sure that existing non-conformities and situations do not happen again. It tries to prevent recurrence by eliminating causes. Corrective Actions address actual problems. Because of this, the corrective action Process can be thought of as a problem-solving Process.
- .2 Hold Point: A mandatory verification point beyond which a Work Process shall not proceed without authorization by Consultant. Hold Points may be nominated by Consultant. The issuance of a Non-Conformance or Corrective Action report by Consultant automatically creates a Hold Point for the Work Processes affected.
- .3 Inspection and Testing Plan (ITP): A document that records the inspection and testing requirements of the Contract. The Inspection and Testing Plan identifies the items of materials and Work to be inspected or tested, by whom and at what stage or frequency, Hold and Witness Points, references to relevant standards, acceptance criteria, and the records to be maintained.
- .4 Mock-up: a full-size model of a portion of the Work made with the same construction techniques and materials that will be used to meet the requirements of the Contract Documents, and constructed by the same personnel that will be performing the Work at the Site.
- .5 Non-conforming Product: When one or more characteristics of a Product fail to meet specified requirements, it is referred to as a Non-Conforming Product. When a Product deviates from specified Product requirements, it fails to conform. Non-conforming Products must be identified and controlled to prevent unintended use or delivery.

- .6 Preventative Actions: Steps that are taken to remove the causes of potential non-conformities or potential undesirable situations. The preventive action Process is designed to prevent the occurrence of non-conformities or situations that do not yet exist. It tries to prevent occurrence by eliminating causes. While Corrective Actions prevent recurrence, Preventive Actions prevent occurrence. Both types of actions are intended to prevent non-conformities. In general, the preventive action Process can be thought of as a risk analysis Process.
- .7 Process: An integrated set of activities that uses resources to transform inputs into outputs. A system exists whenever several Processes are interconnected using such input-output relationships. Processes are interconnected because the output from one Process becomes the input for another Process.
- .8 Product: A Product is the output of a Process. Products can be tangible or intangible.
- .9 Quality: Is a set of features or properties of a Product, Process, or system compared with a set of requirements. If those features or properties meet all requirements, 'High Quality' is achieved; if those features or properties do not meet all requirements, 'Low Quality' is achieved.
- .10 Quality Assurance (QA): Proactive activities used to provide confidence that Quality requirements will be fulfilled. Quality Assurance activities are determined before Work begins and these activities are performed while the Work is being executed. Examples of Quality Assurance include, but are not limited to, the following:
  - .11 Process checklists.
  - .12 Quality system audits.
  - .13 Methodology and standards development.
- .14 Quality Control (QC): Activities used to evaluate Products for conformance to Contract requirements. Example of Quality Control activities include, but are not limited to, inspection and testing.
- .15 Quality Management (QM): Includes all the activities used to direct, control, and coordinate Quality. These activities include formulating a Quality policy and setting Quality objectives. They also include Quality planning, Quality Control, Quality Assurance, and Quality improvement.
- .16 Quality Management System (QMS): Is a set of interrelated or interacting elements used to direct and control how Quality policies are implemented and Quality objectives are achieved.
- .17 Quality Plan: A document that is used to specify the procedures and resources that will be needed to carry out a specific contract, perform a Process, realize a Product, or manage a contract. Quality Plans also specify who will do what and when.
- .18 Witness Point: An identified point in a Process where Consultant may review, witness, inspect or undertake tests on any component, method or Process of the Work. Consultant may or may not take the opportunity. Notification of Witness Points must be provided to Consultant no less than 7 calendar days in advance so that attendance may be scheduled if elected.

### 1.3 **CONTRACTOR'S QUALITY MANAGEMENT SYSTEM**

- .1 The Contractor shall establish, document, implement and maintain a Quality Management System in a manner consistent with the ISO 9001:2008 Quality Management System Requirements, using a Process approach.

- .2 The Contractor shall provide a Quality Plan describing the Quality Management System as it applies to this Contract. The Contractor shall attach, at minimum, the following procedures to the Quality Plan:
  - .1 Control of documents: A documented procedure shall be established to define the controls needed:
    - .1 To approve documents for adequacy prior to issue.
    - .2 To review and update as necessary and re-approve documents.
    - .3 To ensure that changes and the current revision status of documents are identified.
    - .4 To ensure that relevant versions of applicable documents are available at points of use.
    - .5 To ensure that documents remain legible and are readily identifiable.
    - .6 To ensure that documents of external origin necessary for the planning and operation of the QMS are identified and distribution controlled.
    - .7 To prevent the unintended use of obsolete documents, and to apply suitable identification to them if they are retained for any purpose.
  - .2 Control of records: A documented procedure to define the controls needed for the identification, storage, protection, retrieval, retention and disposition of records. Records shall remain legible, readily identifiable and retrievable.
  - .3 Internal audit: A documented procedure to define the responsibilities and requirements for planning and conducting audits, establishing and maintaining records, and reporting results.
  - .4 Control of Non-Conforming Product: A documented procedure to define the controls and related responsibilities and authorities for dealing with Non-Conforming Product.
  - .5 Corrective Actions: Establish a documented procedure to define requirements for:
    - .1 Reviewing non-conformities (including Owner or Consultant complaints).
    - .2 Determining the causes of non-conformities.
    - .3 Evaluating the need for action to ensure that non-conformities do not recur.
    - .4 Determining and implementing the actions needed.
    - .5 Recording the results of the actions taken.
    - .6 Reviewing the effectiveness of the Corrective Actions taken.
  - .6 Preventive Actions: Establish a documented procedure to define requirements for:
    - .1 Determining potential non-conformities and their causes.
    - .2 Evaluating the need for action to prevent occurrence of non-conformities.
    - .3 Determining and implementing the actions needed.
    - .4 Recording the results of the actions taken.
    - .5 Reviewing the effectiveness of the Preventative Actions taken.
- .3 Submit Quality Plan to Consultant for review and approval in accordance with the requirements of Section 01 33 00 – Submittal Procedures; submit within 15 Working Days of award of Contract and allow 10 Working Days for Consultant's review.

#### **1.4 REVIEW AND INSPECTION**

- .1 Do not cover work by other work until inspected and accepted. Generally, no Work shall be covered or otherwise made difficult or impossible to review prior to review.
- .2 Notify Consultant minimum 5 Working Days in advance of Hold Points and Witness Points, or in ample time as required to maintain Construction Schedule, whichever period is longer.
- .3 Allow Owner and Consultants access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .4 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultant instructions, or law of Place of Work.
- .5 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .6 Consultant may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

#### **1.5 INDEPENDENT INSPECTION AGENCIES**

- .1 Refer to Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
- .2 Independent Inspection/Testing Agencies may be engaged by Owner for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Owner.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents or replace the Contractor's quality management program of oversight, testing and inspection.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to Owner. Pay costs for retesting and re-inspection.

#### **1.6 ACCESS TO WORK**

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Cooperate to provide reasonable facilities for such access.

#### **1.7 PROCEDURES**

- .1 Notify appropriate agency and Consultant in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

## **1.8 REJECTED WORK**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Consultant.

## **1.9 REPORTS**

- .1 Submit electronic copies in PDF format of inspection and test reports to Consultant.
- .2 Provide copies to Subcontractor of work being inspected or tested, or manufacturer or fabricator of material being inspected or tested.

## **1.10 TESTS AND MIX DESIGNS**

- .1 Furnish test results and mix designs as directed by Consultant, as specified in the technical Sections, and/or as required by authorities having jurisdiction; refer to Section 01 29 83 - Payment Procedures Testing Laboratory Services.

## **1.11 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specification Sections. Include for Work of all Sections required to provide mock-ups.
- .2 Construct in all locations acceptable to Consultant and as specified in specific Section.
- .3 Prepare mock-ups for Consultant's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
  - .1 Allow 10 working days in construction schedule for the review of mock-ups after they have been prepared.
  - .2 Provide 10 working day's notice for mock-up review to Consultant in advance of preferred review date(s).
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 Mock-Ups Required by Specific Technical Specification Sections:
  - .1 If noted in the technical section, remove mock-up at conclusion of Work, or when acceptable to Consultant.
  - .2 Mock-up(s) may remain as part of Work if so stated in the technical specification section.
  - .3 Specification sections identify whether mock-up may remain as part of Work or if it is to be removed and when.

## **1.12 MILL TESTS**

- .1 Submit mill test certificates as required of specification Sections.

**1.13            EQUIPMENT AND SYSTEMS**

- .1        Submit adjustment and balancing reports for mechanical, electrical, and building equipment systems.
- .2        Refer to technical Sections for requirements.

**END OF SECTION**

**1.1 INSTALLATION AND REMOVAL**

- .1 Provide temporary utilities and controls as required in order to execute Work expeditiously.
- .2 Remove from site all temporary Work after use.

**1.2 DEWATERING**

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

**1.3 FIRE PROTECTION**

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

**1.4 COORDINATION**

- .1 Contractor to obtain and pay for all permits necessary for the connection to existing utilities in public right-of-way.
- .2 Contractor to coordinate connections and road closures with applicable City of Charlottetown Departments and authorities having jurisdiction.

**1.5 WATER SUPPLY**

- .1 Arrange and pay for a temporary supply of water required during construction.
- .2 Connect to and use Owner's water supply once installed for temporary use during construction, subject to existing available volume and pressure. Reimburse Owner's utility costs based on metered usage. Owner will install a sub-meter for this purpose.
- .3 Arrange and pay for necessary water supply connections and disconnections.

**1.6 TEMPORARY HEATING AND VENTILATING**

- .1 Arrange and pay for temporary heating and ventilation required during construction.
- .2 Vent construction heaters in enclosed spaces to the outside or use flameless type of construction heaters.
- .3 Provide temporary heat for the Work as required to:
  - .1 Facilitate progress of Work.
  - .2 Protect the Work against dampness and cold.
  - .3 Prevent moisture condensation on surfaces, freezing, or other damage to finishes or stored Products.
  - .4 Maintain specified minimum ambient temperatures and humidity levels for storage, installation and curing of Products.
  - .5 After building is enclosed, maintain interior temperature of minimum 10 degrees C.
- .4 Provide temporary ventilation for the Work as required to:
  - .1 Prevent accumulations of fumes, exhaust, vapours, gases and other hazardous, noxious, or volatile substances in enclosed spaces, as required to maintain a safe work environment meeting applicable regulatory requirements.



- .2 Ventilate temporary sanitary facilities.
- .5 New permanent building heating and ventilation systems may be used during construction, at Contractor's option. If used during construction:
  - .1 Contractor shall pay utility costs resulting from the use of permanent systems.
  - .2 Operate systems in a non-wasteful and energy efficient manner. Be responsible for any system damage.
  - .3 Just prior to Ready-for-Takeover, replace filters, vacuum clean ducts and perform other required maintenance to ensure systems are in as near as new condition as possible.
  - .4 Ensure that systems manufacturers' warranties do not commence until the date of Ready-for-Takeover or, if manufacturers' warranties do commence earlier when systems are put into use, arrange for necessary extension of manufacturers' warranties or provide equivalent coverage under Contractor's warranty.
- .6 Contractor is responsible for damage to Work due to failure in providing adequate heat and ventilation during construction.

#### **1.7 TEMPORARY POWER AND LIGHT**

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.
- .2 Arrange and pay for necessary connections and disconnections of temporary power and lighting in accordance with regulatory requirements.
- .3 Temporary power for electric cranes and other equipment is responsibility of Contractor.
- .4 Provide and maintain temporary lighting throughout project. Ensure level of illumination is sufficient for the safe execution of the Work and not less than 162 lx.
- .5 New permanent building power and lighting systems may be used during construction, at Contractor's option. If used during construction:
  - .1 Contractor shall pay utility costs resulting from the use of permanent systems.
  - .2 Operate systems in a non-wasteful and energy efficient manner. Be responsible for any system damage.
  - .3 Just prior to Ready-for-Takeover, replace lamps which have been used for more than 3 months.
  - .4 Ensure that systems manufacturers' warranties do not commence until the date of Ready-for-Takeover or, if manufacturers' warranties do commence earlier when systems are put into use, arrange for necessary extension of manufacturers' warranties or provide equivalent coverage under Contractor's warranty.

**END OF SECTION**

**1.1 TRENCHING AND SHORING**

- .1 Comply with O. Reg. 213/91: Construction Projects, Ontario Ministry of Labour's Occupational Health and Safety Act and Regulations, and Technical Standards and Safety Act and Regulations.
- .2 Have shoring designed by a Professional Engineer (P.Eng.) licenced to practice in Ontario.

**1.2 SCAFFOLDING**

- .1 Provide scaffolding and protective or insulating tarps as needed in accordance with CAN/CSA S269.2, Access Scaffolding for Construction Purposes.
- .2 Provide and maintain safe access to Work as required. If access is provided by Contractor, make financial arrangements for use as indicated in Contract.

**1.3 HOISTING**

- .1 Subcontractors and Suppliers shall make financial arrangements with Contractor for use of hoists and cranes for own purposes.
- .2 Hoists and cranes shall be operated by qualified operator, and provided as required by Contractor.

**1.4 SITE STORAGE AND LOADING**

- .1 Do not unreasonably encumber premises with Products and materials.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

**1.5 CONSTRUCTION PARKING**

- .1 Provide and maintain adequate access to project site, and arrange for parking as required.

**1.6 SECURITY**

- .1 Contractor is responsible for the security and protection of its Products, materials, tools, equipment, and other items brought to the site for performance of the Work.
- .2 Perimeter fencing shall be provided by Contractor for the protection of the general public.

**1.7 OFFICES**

- .1 General meetings involving various parties shall be held at the site offices of the Contractor and/or electronically to be arranged by Contractor, with meetings recorded and transcribed through AI (Artificial Intelligence software). Recordings and transcriptions to be submitted to Owner and Consultant after each meeting. This does not remove Contractor's responsibility for keeping minutes.
- .2 Provide site trailer(s) as required for meetings and secure storage for the use of the Contractor and major trades.
- .3 Provide at no extra cost to Contract a heated and air-conditioned site trailer, complete with all services, password-protected secure Wi-Fi, electricity, lighting, and furniture for the exclusive use of the Owner, Consultant and Owner's Project Manager. This trailer shall be provided as noted for the duration of the Contract.

**1.8 EQUIPMENT, TOOL, AND MATERIALS STORAGE**

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof enclosures as required for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof enclosures on site in manner to cause least interference with work activities, and at direction of Contractor.

**1.9 SANITARY FACILITIES**

- .1 Contractor shall provide sanitary facilities.
- .2 Permanent facilities shall not be used.

**1.10 CONSTRUCTION SIGNAGE**

- .1 Provide and erect project sign, within three weeks of signing Contract in a location designated by Consultant.
- .2 Construction sign of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.
- .3 No other signs or advertisements, other than warning signs, are permitted on site.
- .4 Locate project identification sign as directed by Consultant and construct as follows:
  - .1 Build concrete foundation, erect framework, and attach signboard to framing.
  - .2 Paint surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.
  - .3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.
- .5 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Consultant.

**1.11 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Consultant.
- .2 Provide measures for protection and diversion of traffic, including provision of watchpersons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .3 Protect travelling public from damage to person and property.
- .4 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .5 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .6 Construct access and haul roads necessary.
- .7 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .8 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .9 Dust control: adequate to ensure safe operation at all times.

- .10 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Consultant.
- .11 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .12 Provide snow removal during period of Work.
- .13 Remove, upon completion of work, haul roads designated by Consultant.

**1.12 DAILY CLEAN-UP**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

**END OF SECTION**

**1.1 INSTALLATION AND REMOVAL**

- .1 Provide temporary controls as required in order to expedite Work.
- .2 Remove from site all such Work after use.

**1.2 HOARDING**

- .1 Fencing and Siltation Controls: comply with local and Province of Ontario regulations, by-laws and ordinances.
- .2 Erect temporary site enclosure using purpose-made, prefabricated interlocking metal fence panels, minimum 2.1 m high. Perimeter fencing shall be structurally adequate and designed and installed to prevent children and adults from accessing the worksite.
  - .1 Have lightning grounding protection installed by a licenced electrician.
- .3 Provide lockable truck entrance gates and at least one pedestrian entrance as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.
- .4 Erect and maintain pedestrian walkways including roof and side covers complete with signs and electrical lighting as required by law.
- .5 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

**1.3 GUARD RAILS AND BARRICADES**

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Provide as required by authorities having jurisdiction.
- .3 Ensure that all risks associated with working at heights meets all applicable federal and provincial laws and regulations, and governing local regulations, by-laws and ordinances. Include project-specific safety mitigation plans in health and safety plan and procedures in compliance with the requirements of Section 01 35 29 - Health and Safety Requirements.

**1.4 WEATHER ENCLOSURES**

- .1 Provide weathertight closures to unfinished door and window openings, temporary partitions exposed to the exterior, and openings in roofs.
- .2 Seal off openings and enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.
- .4 Construct and provide weather protection as necessary to prevent water, ice, and snow from entering wall systems during construction or damaging work in progress.

**1.5 DUST TIGHT SCREENS**

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work, and public.
- .2 Maintain and relocate protection until such work is complete.

**1.6 ACCESS TO SITE**

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

**1.7 PUBLIC TRAFFIC FLOW**

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

**1.8 FIRE ROUTES**

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

**1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY**

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

**1.10 PROTECTION OF BUILDING FINISHES**

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Consultant locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of protection or improper or inadequate protection.

**END OF SECTION**

## **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract, as amended.
- .2 Within text of each specifications Section, reference may be made to reference standards.
- .3 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .4 If there is question as to whether products or systems are in conformance with applicable standards, Consultant reserves right to have such products or systems tested to prove or disprove conformance.
  - .1 Cost for such testing will be borne by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.

## **1.2 GENERAL**

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

## **1.3 PRODUCT OPTIONS**

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

## **1.4 PRODUCT AVAILABILITY AND DELIVERY TIMES**

- .1 Promptly upon Contract award and periodically during construction, review and confirm Product availability and delivery times. Order Products in sufficient time to meet the construction progress schedule and the Contract Time.
- .2 If a specified Product is no longer available, promptly notify Consultant. Consultant will take action as required.
- .3 If delivery delays are foreseeable, for any reason, promptly notify Consultant.
  - .1 If a delivery delay is beyond Contractor's control, Consultant will provide direction.

- .2 If a delivery delay is caused by something that was or is within Contractor's control, Contractor shall propose actions to maintain the construction progress schedule for Consultant's review and acceptance.

## **1.5 STORAGE, HANDLING AND PROTECTION**

- .1 Store, handle, and protect Products during transportation to Place of the Work and before, during, and after installation in a manner to prevent damage, adulteration, deterioration and soiling.
- .2 Comply with manufacturer's instructions for storage, handling and protection.
- .3 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in Work.
- .4 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of Safety Data Sheets (SDS).
- .5 Store Products subject to damage from weather in weatherproof enclosures.
- .6 Store sheet Products on flat, solid, supports and keep clear of ground. Slope to shed moisture.
- .7 Remove and replace damaged Products.

**END OF SECTION**



## **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract, as amended.
- .2 Owner's identification of existing survey control points and property limits.

## **1.2 QUALIFICATIONS OF SURVEYOR**

- .1 Contractor shall contract the services of a Professional Land Surveyor licensed to practice in Ontario.
- .2 Surveyor shall be a member in good standing of provincial surveyors licensing organization, and have a current Certificate of Authorization.

## **1.3 SURVEY REFERENCE POINTS**

- .1 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .2 Make no changes or relocations without prior written notice to Consultant.
- .3 Report to Consultant when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .4 Require surveyor to replace control points in accordance with original survey control.

## **1.4 SURVEY REQUIREMENTS**

- .1 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data, in Project record and as-built documents.
- .2 Establish lines and levels, locate and lay out, by instrumentation.
- .3 Stake for grading, fill and topsoil placement and landscaping features.
- .4 Stake slopes and berms.
- .5 Establish pipe invert elevations.
- .6 Stake batter boards for foundations.
- .7 Establish foundation layouts and locations of footings.
- .8 Establish foundation column locations and floor elevations.
- .9 Establish lines and levels for mechanical and electrical site services.

## **1.5 EXISTING SERVICES**

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Consultant of findings.
- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Consultant.

## **1.6 LOCATION OF EQUIPMENT AND FIXTURES**

- .1 Location of equipment, fixtures and outlets indicated on design Drawings or specified are to be considered as approximate; exact locations to be determined by appropriate Subcontractors in consultation with Contractor and Consultant; avoid conflicts and interferences.

- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Consultant of impending installation and obtain acceptance for actual locations if different than as shown on the design Drawings.
- .4 Submit field drawings to indicate relative position of various services and equipment if different than as shown on the design Drawings.

#### **1.7 AS-BUILT RECORDS**

- .1 Maintain a complete accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site work, prepare a survey showing dimensions, locations, angles and elevations of Work, including foundations, piles, grade beams and site services. Locate slab corners at each elevation grade and columns.
- .3 Record locations of maintained, re-routed and abandoned service lines.

#### **1.8 SURVEYOR'S REAL PROPERTY REPORT (SRPR)**

- .1 Contractor shall contract the services of a professional Land Surveyor licensed to practice in the Place of the Work and acceptable to Consultant.
- .2 Surveyor shall be a member in good standing of the provincial surveyors licensing organization and have a current Certificate of Authorization.
- .3 At Substantial Performance have licensed Surveyor complete and certify a Real Property Report and submit original to Owner with copy to Consultant.

#### **1.9 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit name and address of Surveyor to Consultant.
- .2 On request of Consultant, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting elevations and locations of completed as-built Work, identifying elements not in conformance with Contract Documents.
- .4 Submit final as-built survey electronically in a CAD format acceptable to Consultant (non-password protected).
  - .1 Scale:
    - .1 Plans: Not less than 1:50.
    - .2 Sections: Not less than 1:20.
    - .3 Details: Not less than 1:10.

#### **1.10 SUBSURFACE CONDITIONS**

- .1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Change Directives and Change Orders.

**END OF SECTION**

**1 SCOPE OF APPLICATION OF THIS SECTION**

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

**2 MANUFACTURER'S INSTRUCTIONS**

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

**3 CONCEALMENT**

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

**4 FASTENING – GENERAL**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials.
- .2 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.
- .3 Use SAE Type 316 or 316L stainless steel fasteners and anchors for securing exterior work and in spaces where high humidity levels are anticipated.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

**5 FASTENING – EQUIPMENT**

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

**6 FIRE RATED ASSEMBLIES**

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

**7 LOCATION OF FIXTURES, OUTLETS AND DEVICES**

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

**8 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS**

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

**9 REMEDIAL WORK**

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

**END OF SECTION**

## **1.1 SUMMARY**

- .1 Section specifies requirements for incidental cutting, fitting, and patching required to complete the Work and make its many parts fit together properly.

## **1.2 REQUEST FOR CUTTING, PATCHING AND REMEDIAL WORK**

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

## **1.3 PRODUCTS**

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

## **1.4 PREPARATION**

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

## **1.5 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services' utilities, execute the Work at times directed by local governing authorities, with a minimum of disturbance to the Work, pedestrian and vehicular traffic, and ongoing operations of adjacent facilities.

**1.6 CUTTING, PATCHING, AND REMEDIAL WORK**

- .1 Coordinate and perform the Work to ensure that cutting and patching work is kept to a minimum.
- .2 Perform cutting, fitting, patching, and remedial work, including excavation and fill if applicable, to make the affected parts of the Work come together properly and complete the Work.
- .3 Provide openings in non structural elements of the Work for penetrations of mechanical and electrical work.
- .4 Perform cutting by methods to avoid damage to other work
- .5 Provide proper surfaces to receive patching, remedial work, and finishing.
- .6 Perform cutting, patching, and remedial work using competent and qualified specialists familiar with the Products affected, in a manner that neither damages nor endangers the Work.
- .7 Do not use pneumatic or impact tools without Consultant's prior approval.
- .8 Ensure that cutting, patching, and remedial work does not jeopardize manufacturers' warranties.
- .9 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.
- .10 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping.
- .11 Maintain fire ratings of fire rated assemblies where cutting, patching, or remedial work is performed. Completely seal voids or penetrations of assembly with firestopping material to full depth or with suitably rated devices.

**END OF SECTION**

## **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract, as amended.

## **1.2 GENERAL CLEANING REQUIREMENTS**

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

## **1.3 PROGRESSIVE CLEANING**

- .1 Maintain the Work in a tidy and safe condition, free from accumulation of waste materials and construction debris.
- .2 Provide appropriate, clearly marked, containers for collection of waste materials and recyclables.
- .3 Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each Working Day. Collect packaging materials for recycling or reuse.
- .4 Remove waste materials and recyclables from Place of the Work at regular intervals, and as required to maintain site unencumbered, sanitary and safe.
- .5 Clean interior building areas prior to start of finish work and maintain free of dust and other contaminants during finishing operations.
- .6 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.
- .7 Where public sidewalks are contiguous to the worksite, clear snow and ice from public sidewalks as required to comply with applicable municipal regulatory requirements.

## **1.4 FINAL CLEANING**

- .1 Remove and dispose of waste in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Before final cleaning, arrange a meeting at Place of the Work to determine the acceptable standard of cleaning. Ensure that Owner, Consultant, Contractor and cleaning company are in attendance.
- .3 Remove from Place of the Work surplus Products, waste materials, recyclables, Temporary Work, and Construction Equipment not required to perform any remaining work.
- .4 Provide professional cleaning by a qualified, established cleaning company.
- .5 Lock or otherwise restrict access to each room or area after completing final cleaning in that area.
- .6 Re-clean as necessary areas that have been accessed by Contractor's workers prior to Owner occupancy.

- .7 Remove stains, spots, marks, and dirt from finished surfaces, electrical and mechanical fixtures, furniture fitments, walls, floors, and ceilings.
- .8 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and all other finished surfaces, including mechanical and electrical fixtures. Replace broken, scratched or otherwise damaged glass.
- .9 Remove dust from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.
- .10 Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres and screens, and above suspended ceiling tiles.
- .11 Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.
- .12 Remove waste material and debris from crawlspaces and other accessible concealed spaces.
- .13 Remove stains, spots, marks, and dirt from exterior facades.
- .14 Clean exterior and interior window glass and frames.
- .15 Clean and sweep roofs and clear roof drains.
- .16 When temperatures are above freezing and will remain above freezing for minimum 72 hours, power wash exterior sidewalks, steps, driveways, parking lots and drive lanes and other paved surfaces. When temperatures are below or approaching freezing temperatures, power-sweep clean exterior sidewalks, steps, driveways, parking lots and drive lanes and other paved surfaces. If snow covered, remove snow and ice from exterior sidewalks, steps, driveways, parking lots and drive lanes and other paved surfaces prior to power-sweeping.
- .17 Use leaf blowers to clean landscaped surfaces.

**END OF SECTION**



## **1 WASTE MANAGEMENT REQUIREMENTS**

- .1 Construction Waste Management and Disposal Requirements: comply with Province of Ontario and County of Brant regulations and by-laws.
- .2 Reduce solid waste produced by Work in accordance with CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.
- .3 Comply with Ontario Ministry of the Environment Regulations 102/94 and 103/94.
- .4 Comply with County of Brant construction and demolition waste transportation and disposal policies and procedures.
- .5 Handle and dispose of waste materials in accordance with the Canadian Environmental Protection Act, 1999 (S.C. 1999, c. 33) and applicable Regulations made under the Act.
- .6 Use only those brokerage, storage, transfer and disposal facilities which comply with federal, provincial, and local requirements, and are licenced to handle and dispose of the materials delivered.

## **2 STORAGE, HANDLING AND PROTECTION**

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Consultant.
- .2 Unless specified or indicated on Drawings otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Consultant.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove comingled materials to off-site processing facility for separation.
  - .3 Provide waybills for separated materials.

## **3 DISPOSAL OF WASTES**

- .1 Separate waste streams as required to minimize actual waste that goes to landfills; divert as much compliant waste as possible to recycling and reuse facilities.
- .2 Do not bury rubbish or waste materials.
- .3 Do not dispose of waste, volatile materials, mineral spirits, oil, and paint thinner into waterways, storm, or sanitary sewers.

- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

#### **4 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility, and also provide temporary security measures approved by Consultant when required to assure continuity of security.

#### **5 SCHEDULING**

- .1 Coordinate waste management activities with other activities at site to ensure timely and orderly progress of Work, and lawful collection, transportation, recycling and disposal and construction/demolition waste product.

#### **6 APPLICATION**

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with governing regulations and codes.

#### **7 CLEANING**

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

**END OF SECTION**

## **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract, as amended.
- .2 ULC Standards
  - .1 CAN/ULC S1001-11, Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

## **1.2 SUBSTANTIAL PERFORMANCE AND HOLDBACK**

- .1 Declaration of Substantial Performance: when Consultant considers that deficiencies and defects have been corrected, and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance.
- .2 Commencement of Lien and Warranty Periods: comply with Construction Lien Act, R.S.O. 1990, c. C.30, date of Owner's acceptance of published declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by Ontario Construction Lien Act.
- .3 Final Payment: when Consultant considers final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. If Work is deemed incomplete by Consultant, complete outstanding items and request re-inspection.
- .4 Payment of Holdback: after issuance of certificate of Substantial Performance of Work, submit application for payment of holdback.

## **1.3 READY-FOR-TAKEOVER**

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

## **1.4 INSPECTION AND REVIEW BEFORE READY-FOR-TAKEOVER**

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

Takeover and no items remain on the Contractor's list of items to be completed or corrected.

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

## **1.5 PREREQUISITES TO FINAL PAYMENT**

- .1 After Ready-for-Takeover of the Work and before submitting an application for final payment in accordance with the General Conditions of Contract:
  - .1 Correct or complete all remaining defective, deficient, and incomplete work.
  - .2 Release of Deficiency Holdback, per Section 01 29 00 Payment Procedures, is dependent on Consultant's review and acceptance of corrective work. Note that if the Owner has been required to correct deficiencies because of failure to do so by Contractor, any associated costs will be deducted from holdback amount; the Owner will provide relevant receipts and invoices to support any deductions made from the holdback return.
  - .3 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.
  - .4 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified in Section 01 74 11 – Cleaning and Section 01 74 19 - Waste Management and Disposal.
  - .5 Submit written certificate that following have been performed:
    - .1 Work has been completed and inspected for compliance with Contract Documents.
    - .2 Defects have been corrected and deficiencies have been completed.
    - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
    - .4 Certificates required by authorities having jurisdiction, fire commissioner and utility companies have been submitted.
    - .5 Verification letter required to confirm integrated systems testing for fire protection and life safety systems has been successfully completed in accordance with CAN/ULC S1001. Note that commissioning is a Cash Allowance item, per Section 01 21 00 – Allowances.
    - .6 Operation of systems have been demonstrated to Owner's personnel.

## **1.6 CLEANING**

- .1 In accordance with Section 01 74 11 – Cleaning.
- .2 Remove waste and surplus materials, and construction facilities from the site in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## 1.1 GENERAL

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Refer to and comply with the requirements of CCDC 2–2020 **GC 12.1 READY-FOR-TAKEOVER**.
- .2 The procedures for completing Contract and acceptance by the Owner shall be as required by Ontario Construction Lien Act, requirements of authorities having jurisdiction, and CCDC 2–2020 as amended.
- .3 Procedures and timelines will be reviewed to ensure that parties understand their responsibilities.
  - 1. Refer to Section 01 31 19 for procedures and requirements.
- .4 Submit to the Consultant a list of closeout submittals required by the Contract Documents.

## 1.2 CLOSEOUT SUBMITTALS

- .1 Collect reviewed submittals, and assemble required closeout submittals executed by Subcontractors, Suppliers, and manufacturers. Prior to submitting closeout submittals to the Consultant, 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 Contract Documents and manufacturers.
  - .3 Review change orders, holdbacks and other adjustments to the Contract.
  - .4 Review inspection and testing reports to verify conformance to intent of Contract Documents 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 adjustments to the Contract, previous payments, and monies remaining at time of application for completion of the Contract. Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made.
- .2 No later than 10 Working Days prior to submitting request for Consultant's review to determine if Substantial Performance of the Work has been achieved, submit to the Consultant 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 Consultant'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 Consultant, of acceptable copies of the closeout submittals required herein and by the Contract Documents.

- .6 Record documents:
  - .1 Accurately record changes to the Work and deviations from Contract Documents as the Work progresses.
  - .2 Mark changes in red ink.
  - .3 Record, 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 Field changes of dimensions/details.
    - .6 Changes by change order/change directive/supplemental instructions.
    - .7 Locations of interior mechanical and electrical equipment and distribution.
    - .8 Elevations and location depths of services. Identify type and size of service and materials used.
    - .9 As-built specifications manuals: Record as-built Products, including manufacturer, manufacturer's model or system number and finish / finish system.
- .7 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, etc.
  - .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;
    - .4 One-line diagrams of steam distribution, hot and cold water systems, including risers, valves, control devices, etc.
- .8 Operation and maintenance manuals:
  - .1 Submit one hard copy and two electronic copies on USB flash drives or uploaded to designated construction management software of maintenance manuals, consisting of the following general components:
    - .1 Shop drawing manuals,
    - .2 Warranty manuals, and

- .3 Project data book.
- .2 Operation and maintenance manuals shall contain operating and maintenance data and information specified below for supplied Products, in English, and shall be made up as follows:
  - .1 Have a title page, labelled as applicable, with project name, date and list of contents hot linked to each section and sub-section.
  - .2 Structure the data, including but not limited to preventative maintenance, regular maintenance, and product replacement cycles for the most-critical elements (as determined by Owner).
  - .3 Organize contents into applicable sections of work to parallel project specifications break-down. Label each section clearly.
  - .4 Neatly type lists and notes. Use clear drawings, diagrams of manufacturers' literature.
- .3 Shop drawing manuals:
  - .1 Submit one electronic copy of each final accepted shop drawing issued for the Work on that have recorded changes made during fabrication and installation caused by unforeseen conditions.
- .4 Warranty and Extended Warranties:
  - .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 Contract.
- .5 Project data book: include the following information supplemented by additional required data specified elsewhere in the Contract Documents:
  - .1 Maintenance instruction for finished surfaces and materials.
  - .2 Electronic copy of hardware and paint schedules.
  - .3 Description, operation and maintenance instructions for equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
- .6 Names, addresses and phone numbers of Subcontractors and Suppliers, as applicable.
- .7 Additional material used in the Work listed under various sections showing name of manufacturer and source of supply.
- .8 Charts, diagrams and reports identified in electrical and mechanical divisions of the specifications.
- .9 Report recording demonstration and instruction provided to Owner's personnel for operation and maintenance of building systems as described below in this section.
  - .1 Permits and forms:
    - .1 Occupancy permit; statutory declarations.
    - .2 Workplace Safety & Insurance Board certificate of clearance.
    - .3 Certificates of approval of the Work by local building department (if available).
    - .4 Electrical authority certificate of inspection.

- .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.
  - .2 Use unbroken cartons, or if not supplied in cartons, material shall be strongly packaged.
  - .3 Clearly mark cartons or packaging with contents, project name, and Supplier.
  - .4 If applicable, give colour and finish, room number or area where material is used.
  - .5 Replace incorrect or damaged maintenance materials delivered to Owner, including damage through shipment.
  - .6 Provide inventory list of maintenance materials prior to Substantial Performance of the Work application. List all items, complete with quantities, and storage locations.
  - .7 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.

### 1.3 **SYSTEM DEMONSTRATION AND PROJECT COMMISSIONING**

- .1 Refer to requirements of other Divisions for additional requirements related to demonstration and commissioning for site services, elevators, mechanical systems, and electrical systems.
- .2 Perform system demonstration and commissioning work no later than 10 Working Days prior to submitting request for Consultant's review to determine if Substantial Performance of the Work has been achieved.
  - .1 Note that commissioning is a Cash Allowance item, per Section 01 21 00 – Allowances.
- .3 Submit required certificates of approval or acceptance from authorities having jurisdiction.
- .4 Meet with other consultants, including 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 certified from time specified.
- .6 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.
- .7 Demonstration and Instruction:
  - .1 Demonstrate operation of each system to Owner.
  - .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 by Suppliers and Subcontractors.
  - .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 Consultant 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.
- .8 Correct deficiencies and defects identified during demonstration, instruction, or commissioning.
- .9 Attend 'end-of-work' testing and break-in or start-up demonstration.

#### **1.4 SUBSTANTIAL PERFORMANCE OF THE WORK**

- .1 Deficiency review:
  - .1 Contractor assumes prime responsibility for ensuring that items shown and described in the Contract Documents are complete. Any reviews to approve the certificate of Substantial Performance of the Work will be immediately cancelled if it becomes obvious to the Consultant that extensive deficiencies are outstanding.
  - .2 No later than 10 Working Days after the receipt of the Contractor's request described above, but contingent upon the prior receipt, by the Consultant, of the closeout submittals in the manner and form specified in this section, the Consultant 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 Consultant. During review, the Consultant 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.
  - .3 Provide a schedule of planned deficiency review having regard to the foregoing.
- .2 Certification of Substantial Performance of the Work:
  - .1 When the Consultant considers that the deficiencies and defects have been completed and that it appears that the requirements of the Contract Documents have been substantially performed, the Consultant shall issue a certificate of Substantial Performance of the Work to the Contractor, stating the date of Substantial Performance of the Work.
  - .2 Commencement of Lien and Warranty Periods: shall be in compliance with Ontario Construction Lien Act; date of Owner's acceptance of published declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by Ontario Construction Lien Act.
- .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 Substantial Performance of the Work to verify its completion in accordance with the requirements of the Contract Documents, the Contractor shall submit a written request for a final review by the Consultant, 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 Consultant 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 Consultant and the Contractor, unless a specific date is required by Contract, and a further review by the Consultant 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.
- .7 Return Project documentation to Owner at completion of the Contract.

## **1.5 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Consultant for approval.
- .3 Warranty management plan to include required actions and documents to assure that Owner receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Consultant for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

- .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, fire protection.
- .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
  - .1 Name of item.
  - .2 Model and serial numbers.
  - .3 Location where installed.
  - .4 Name and phone numbers of manufacturers or suppliers.
  - .5 Warranties and terms of warranty: include two-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
  - .6 Cross-reference to warranty certificates as applicable.
  - .7 Starting point and duration of warranty period.
  - .8 Summary of maintenance procedures required to continue warranty in force.
  - .9 Organization, names and phone numbers of persons to call for warranty service.
- .9 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .10 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Consultant to proceed with action against Contractor.

**END OF SECTION**

**1.1 DESCRIPTION**

- .1 Demonstrate and provide training to Owner's personnel on operation and maintenance of equipment, building envelope and systems minimum two weeks prior to scheduled date of Ready-for-Takeover of the Work.
- .2 Owner will provide list of personnel to receive training and will coordinate their attendance at agreed upon times.
- .3 Coordinate and schedule demonstration and training provided by Subcontractors and Suppliers.

**1.2 QUALITY ASSURANCE**

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
  - .1 Instruct Owner's personnel.
  - .2 Provide written report that demonstration and instructions have been completed.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 PREREQUISITES TO DEMONSTRATION AND TRAINING**

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

**1.5 DEMONSTRATION AND TRAINING**

- .1 Demonstrate start up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment and system at agreed upon times, at the equipment or designated location
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

- .5 All training sessions must be video recorded, sound and video, by a professional videographer and be of sufficient quality and clarity, visually and audibly, to be able to serve as standalone staff training in the future.
- .6 Minimum time allocated for Instruction:
  - .1 Operable Windows: ½-hour.
  - .2 Doors with automatic operators: ½-hour.
  - .3 Finishes (floors, walls, ceilings): ½-hour per finish.
  - .4 Division 10 - Specialties: ½ hour each for each item.
  - .5 Roofing: 1- hour.
  - .6 Trees, Shrubs & Ground Covers: 1-hour.
  - .7 Pumps: 1-hour.
  - .8 Tanks: 1-hour.
  - .9 Plumbing: 2-hours.
  - .10 Chemical: 1-hour plus monthly visits during first year following Substantial Performance.
  - .11 Fire Protection: 1-hour.
  - .12 Boilers: 1-hour.
  - .13 Glycol: ½-hour.
  - .14 HVAC: 1-hour per system.
  - .15 Photovoltaic (PV) system: 1-hour.
  - .16 Building Automation System (BAS): 20 hours (overall) instruction and support as required during the first 2 years following certificate of Substantial Performance.
  - .17 Controls - General: 20 hours (overall) instruction and support as required during the first 2 years following certificate of Substantial Performance.
  - .18 Refer to mechanical and electrical Specifications for additional training and demonstration requirements.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Section 03 35 10 - Concrete Floor and Slab Finishing.
- .3 Section 07 92 00 - Joint Sealants.

**1.2 REFERENCES**

- .1 American Association of State Highway and Transportation Officials (AASHTO)
  - .1 AASHTO-T-259-02 (2021), Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration.
- .2 ASTM International (ASTM)
  - .1 ASTM D1653-13(2021), Standard Test Methods for Water Vapor Transmission of Organic Coating Films.
  - .2 ASTM D4262-05(2018), Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
  - .3 ASTM F710-22, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
  - .4 ASTM F1869-23, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
  - .5 ASTM F2170-19a, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
  - .6 ASTM G152-13(2021), Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.
  - .7 ASTM G153-13(2021), Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.
- .3 Canadian Standards Association (CSA):
  - .1 CSA S413:21, Parking Structures, Includes Administrative Update (2022).
- .4 National Cooperative Highway Research Program (NCHRP)
  - .1 NCHRP Report 244 - Series II, Water Absorption, Water Vapor Transmission and Chloride Intrusion.

**1.3 PRE-INSTALLATION MEETING**

- .1 With at least 1-week prior notice, sealer applicator shall meet with the necessary parties at the jobsite in accordance with Section 01 31 19 – Project Meetings to review and discuss project conditions as it relates to the sealer application.
  - .1 Review construction schedule and project requirements.
  - .2 Review site conditions.
  - .3 Review manufacturer's warranty and installation requirements.
  - .4 Coordination of other trades.
  - .5 Coordination of job site visits by sealer manufacturer.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit the following in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Product Data: Submit manufacturer's published product literature, specifications, test data and application instructions for the specified garage floor sealant to the Consultant. Keep copies at the jobsite for reference by workers.

#### **1.5 QUALITY ASSURANCE**

- .1 Refer to and comply with the requirements of Section 03 35 10 - Concrete Floor and Slab Finishing, item **1.6 QUALITY ASSURANCE**.
- .2 Subcontractor qualifications:
  - 1. Subcontractor shall be approved in writing by the Product manufacturer for the installation of the Product specified. Submit proof of approval to Consultant prior to commencing work of this section.
- .2 Cooperation: Ensure that concrete supplied for slabs contain no admixtures that would be incompatible with floor penetrating sealer.
- .3 Quality control to be in accordance with Section 01 45 00. Independent inspection and testing company shall attend the pre-installation meeting.
- .4 Have manufacturer's technical field representative provide field review in accordance with Section 01 45 00.
- .3 Mock-Ups:
  - .1 Install at jobsite or pre-selected area of building an area for field sample, as directed by Consultant.
  - .2 Provide mock-up of at least 100 sf (9.3 m<sup>2</sup>) to include surface preparation, sealant joint, and juncture details and allow for evaluation of repellent performance and finish.
  - .3 Conduct absorption test on cured field sample.
  - .4 Adjust application until required repellent performance is achieved. The water repellent material shall have penetrated cured field sample at least 2.4 mm (3/32-inch) and shall appear as a band of non-wettable concrete.
  - .5 Apply material in accordance with manufacturer's written application instructions.
  - .6 Manufacturer's representative or designated representative shall review technical aspects; surface preparation, application, and workmanship.
  - .7 Field sample shall be the standard for judging workmanship on remainder of Project.
  - .8 Maintain field sample during construction for workmanship comparison.
  - .9 Do not alter, move, or destroy field sample until Work is completed and approved by Consultant.
  - .10 Obtain Consultant's written acceptance of field sample before start of material application, including approval of aesthetics, colour, texture, and appearance.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- .2 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .3 Store in unopened containers in clean, dry area between 35°F (2°C) and 110°F (43°C).

## **1.7 ENVIRONMENTAL REQUIREMENTS**

- .1 Ambient temperatures shall be between 10°C and 30°C at the time of application.
- .2 Apply coating only when no rain is predicted for a minimum of 4 hours after completion of application.
- .3 No winds in the area to be coated that would cause an improper application rate and unequal cure.

## **Part 2 Products**

### **2.1 HIGH-PERFORMANCE CONCRETE SEALER**

- .1 Single source: use only one material for all sealed concrete floor areas.
- .2 High-Performance Penetrating Water Repellent Silane Sealer:
  - .1 Acceptable Materials:
    - .1 Hydrostop™ Sealer by Kryton International Inc., or
    - .2 Planiseal® WR by Mapei®.

### **2.2 CONCRETE FLOOR SEALER SYSTEM AT MEZZANINE MECHANICAL ROOM**

- .1 Concrete waterproofing, protection and moisture mitigation system with surface water repellent.
- .2 Standard of Acceptance:
  - .1 DualGuard™ with InnerCrete™ Membrane Technology, by Protocol Environmental Solutions Inc.

### **2.3 ACCESSORIES**

- .1 Provide all accessories as required for a complete installation.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Comply with manufacturer's published installation instructions, data sheets and warranty requirements of sealer manufacturer.
- .2 Comply with applicable CSA S413 guidelines.

### **3.2 EXAMINATION**

- .1 Ensure all concrete surfaces to receive treatment have set and cured minimum 28 days.
- .2 Report any observed conditions to the Consultant that would impair the application of the sealer prior to commencing application, and request correction.
- .3 Commencement of application means acceptance of conditions.

### **3.3 LOCATIONS**

- .1 Service areas, and as shown on Drawings.

### **3.4 PREPARATION**

- .1 Verify that substrates are dry and free of curing compounds, sealers, and hardeners.



- .2 Remove all substances that will or are likely to interfere with the penetration of the concrete sealer or affect the resulting appearance of the application using mechanical methods recommended by manufacturer. Do not use solvents.
  - .1 Comply with the requirements of Section 03 35 10, item 3.3.6 Sandblast Finishing: Brush Blast Finish.
- .3 Prepare Substrates according to ASTM F710 including the following:
  - .1 Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  - .2 Perform anhydrous calcium chloride test, ASTM F1869. Results shall not exceed 5 lbs. Moisture Vapor Emission Rate per 1,000 sq. ft. in 24 hours.

- or -
  - .3 Perform relative humidity test using in situ probes, ASTM F2170. Shall not exceed 80%.
  - .4 A pH test for alkalinity shall be conducted. Results shall range between 7 and 9. If the test results are not within the acceptable range of 7 to 9, the installation shall not proceed until the problem has been corrected.
  - .5 Alkalinity and Adhesion Testing: Perform tests recommended by sealer manufacturer.
- .4 Prepare and clean surfaces in accordance with sealer manufacturer's printed instructions.
- .5 Protection: protect plant life and surfaces to remain uncoated during application. Use drop cloths or masking as required.
- .6 Do not apply sealer if standing water is visible on surface to be treated.

### **3.5 HIGH-PERFORMANCE CONCRETE SEALER**

- .1 Apply solution directly as supplied by manufacturer with no dilution or alteration of any kind.
- .2 Stir material thoroughly before and during application.
- .3 Apply solution in accordance with the accepted mock-up procedures.
- .4 Apply sealer with flooding action to specified minimum application rates. Eliminate ponding.
- .5 Apply even distribution of sealer.
- .6 Surfaces shall be immediately back-rolled if product is spray-applied.

### **3.6 CONCRETE FLOOR SEALER SYSTEM AT MEZZANINE MECHANICAL ROOM**

- .1 Spray on surfaces with a fan tip using back and forth motions ensuring even and liberal coverage.
- .2 Product will pool on/run down the surface rather than be absorbed when enough product is used.

- .3 Newer, less porous concrete may require some agitation with a stiff bristle (non-metal) brush to assist in penetration and ensure adequate coverage.
- .4 Product should be applied to saturation but not allowed to pool and dry. If product is still pooled on the surface after 20-30 minutes – wipe, brush or wash away.
- .5 Treated surfaces should be left for 1-2 hours after application so product can be sufficiently absorbed into the substrate.
- .6 If a secondary treatment such as paint, coating or a sealant is to be applied refer to the Manufacturer's Instructions for any subsequent product directions

### **3.7 FIELD TESTING**

- .1 At the sole discretion of the Consultant, a third-party testing agency may be contracted to test penetration of sealer.
  - .1 Two test cores minimum 75 mm diameter x 50 mm deep shall be taken at a location determined by the Consultant.
  - .2 The water repellent material shall have penetrated the core at least 2.4 mm (3/32-inch) and shall appear as a band of non-wettable concrete.
  - .3 If test results show inadequate penetration, reapply sealer to meet minimum depth requirements.

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.9 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.10 SCHEDULE**

- .1 Install appropriate concrete sealer systems at properly prepared concrete floors at locations as identified on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section specifies general concrete finishing requirements. Coordinate with requirements specified and noted on Drawings.

**1.2 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Section 03 05 10 – Concrete Sealers.
- .3 Section 03 35 33 – Stamped Concrete Finishing.
- .4 Section 03 35 44 – Refined Concrete Finishing.
- .5 Section 07 92 00 – Joint Sealants.
- .6 Section 09 30 13 – Tiling.
- .7 Section 09 67 00 – Fluid-Applied Flooring.

**1.3 REFERENCES**

- .1 American Concrete Institute (ACI):
  - .1 ACI 117-10 (R2015), Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary-Reapproved 2015.
  - .1 ACI 117.1R-14, Guide for Tolerance Compatibility in Concrete Construction.
  - .2 ACI 301-20, Specification for Concrete Construction.
  - .3 ACI 302.1R-15, Guide for Concrete Floor and Slab Construction.
  - .4 ACI 302.2R-22, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- .2 ASTM International (ASTM)
  - .1 ASTM A820/A820M-22, Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.
  - .2 ASTM A1064/A1064M -24, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - .3 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .4 ASTM C494/C494M-24, Standard Specification for Chemical Admixtures for Concrete.
  - .5 ASTM C779/C779M-19, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
  - .6 ASTM C1895-20, Standard Test Method for Determination of Mohs Scratch Hardness.
  - .7 ASTM D698-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))
  - .8 ASTM D1751-23, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - .9 ASTM D1752-18(2023), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

- .10 ASTM D4039-09(2023), Standard Test Method for Reflection Haze of High-Gloss Surfaces.
- .11 ASTM D5767-18(2023), Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces.
- .12 ASTM E1155/E1155M-23, Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
- .13 ASTM E1486-14(2022), Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria.
- .14 ASTM F710-22, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- .3 CSA Group (CSA)
  - .1 CSA A23.1:24/CSA A23.2:24, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
  - .2 CAN/CSA A23.3:24, Design of concrete structures.
- .4 International Concrete Repair Institute (ICRI)
  - .1 ICRI 310.2R-2013, Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- .5 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1113-16, Architectural Coatings.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Concrete Floor and Slab Pre-Construction Meeting:
  - .1 Sufficiently in advance of Work so that effected parties have time to accommodate meeting decisions and considerations, arrange for a special pre-construction meeting including the Consultant, Contractor, testing company, concrete floor trade contractors and related Product suppliers, in order to review the project Drawings, Specifications, site conditions, testing procedures, floor finish requirements and any specified mock-up requirements in order to permit compliance with the intent of this Section.

#### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals:
  - .1 Submit manufacturer's published product data sheets and specifications for all products to be incorporated into the work.
  - .2 Submit concrete mix designs for review and comment.
  - .3 Submit floor joint layout, and details of isolation, expansion, construction and control joints.
  - .4 Submit welded steel wire data sheets, including dimensions, wire thickness, and grid.
  - .5 Submit applicable documents required by the referenced CSA Standards.
  - .6 Submit copies of concrete work records.
  - .7 Submit closeout data in accordance with the requirements of Section 01 78 00 - Closeout Submittals:
    - .1 Provide manufacturer's published recommendations for general maintenance, including cleaning instructions and submit a complete list of floor care products that will be required for on-going maintenance.

- .3 Informational Submittals:
  - .1 Qualification Data: for concrete placement and finishing contractors.
  - .2 Minutes of pre-construction meeting.

## 1.6 QUALITY ASSURANCE

- .1 Single source interior floor slab requirement: The following work shall be carried out and/or supervised by a single competent source, being a member of the Concrete Floor Contractors Association or with equivalent experience and expertise, to be responsible to provide or oversee and supervise the complete concrete floor assembly as specified herein, including the supply and installation of concrete materials and all workmanship. The following specialty work shall be performed using the single source approach:
  - .1 Stamped concrete, per Section 03 35 33 – Stamped Concrete Finishing.
  - .2 Polished concrete, per Section 03 35 44 – Refined Concrete Finishing.
- .2 Source Limitations: Use each type or class of cementitious material of the same brand and from the same manufacturer's plant, maintain aggregates and admixtures from a single source continuously throughout the project. Any source variations are to be reported to the concrete purchaser at least 72 hours before the commencement of any concrete placement.
- .3 Concrete Inspection and Testing: the Owner shall engage and pay for a qualified and independent testing agency to perform material evaluation and field inspection and testing as required to ensure specification conformance.
- .4 Mock-Ups:
  - .1 Provide mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .2 Coordinate with appropriate trades as required and provide a mock-up for the following architectural finishes to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship:
    - .1 Sealed concrete, to Section 03 05 10 – Concrete Sealers.
    - .2 Polished concrete, to Section 03 35 44 – Refined Concrete Finishing.
    - .3 Stamped concrete, to Section 03 35 33 – Stamped Concrete Finishing.
    - .4 Aliphatic polyurethane flooring, to Section 09 67 00 Fluid Applied Flooring.
  - .3 Provide slab area approximately 4 sq.m., or as otherwise directed by Consultant, for each specialty floor finish required as noted above.
  - .4 To reduce waste, approved mock-ups may become part of the completed work or may be installed in areas scheduled to receive other applied finishes as directed by the Consultant.
  - .5 Consultant will evaluate mock-ups and may request changes or variations to materials.
  - .6 Accepted mock-ups will form standard for remaining work.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in a manner that prevents damage. Protect adjacent surfaces from damage resulting from the work of this section.
- .2 Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

## **1.8 CONCRETE WORK RECORDS**

- .1 The concrete floor contractor shall keep a written record of each concrete placement, including work location, date, ambient air temperature, relative humidity, granular base temperature, volume of concrete placed, and observations of any unusual factors which may influence quality or appearance.

## **1.9 SITE CONDITIONS**

- .1 Ensure that the building envelope adequately protects concrete from damage caused by wind, rain, high temperatures, freezing or snow damage. Do not use open flame heaters. Ensure adequate fresh air ventilation.
- .2 Comply with manufacturers' published instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting performance.
- .3 Concrete must be cured a minimum of 45 days or as directed by manufacturer before application can begin, and have the specified surface hardness.
- .4 Do not commence with installation until Work yet to be performed will not adversely affect installation of flooring treatments.
- .5 Limit and control excessive dust caused by grinding/polishing procedure.

## **1.10 WARRANTY**

- .1 Concrete floors and slabs shall have an extended warranty against surface deterioration, dusting and cracking for a period of 2-years from the date of Substantial Performance of the Work.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Isolation joints shall be a minimum of 6 mm thick and filled with expanded foam or other compressible joint filler material, by Sika Canada or W.R. Meadows.
- .2 Control joint fillers: self-leveling polyurethane sealant or a 2-part epoxy gel, by Sika Canada, Bomix, Quickcrete or Av-DEC.
- .3 Edge joint filler: to ASTM D1751, bituminous impregnated fibreboard.
- .4 Dowels: round or square smooth steel bars or plates with bond breaker on one end to allow horizontal slippage. Plate dowels shall be installed in accordance with the manufacturer's instructions. Construction joints shall be dowelled with smooth non-deformed bars or plates at all locations.
- .5 Bonding agent: two-component epoxy as manufactured by CPD, Euclid, WR Meadows, Sika. Alternatively, an Acrylic or SBR latex bonding agent may be used when approved by the manufacturer (do not use poly-vinyl acetate (PVA)).
- .6 Welded wire mesh shall conform to the requirements of ASTM A1064M.
- .7 Refer to structural and civil design Drawings for cast-in-place concrete requirements, which, in case of conflict with these specifications, take precedence.
  - .1 Provide all formwork, steel reinforcement and concreting materials and mixes as required for a complete installation.
  - .2 Concrete mixes must conform to CSA A23.1, and have the minimum compressive strengths, water-to-cement ratios, exposure classifications, air content, aggregate sizes and slumps specified by the structural design Drawings.

- .3 Concrete ready-mix manufacturing and delivery shall conform to Canadian Ready Mixed Concrete Association (CRMCA) certification standards and guidelines.
- .4 There shall be no cement substitution with slag or fly ash.
- .5 Admixtures shall be normal setting and non-retarding, and must not increase drying shrinkage.
- .6 Do not use air entrainment for machine-trowel-finished concrete.
- .7 Concrete mixes for polished concrete with exposed aggregate classifications shall be designed with consideration for the type and quantity of fine and coarse aggregates to be used.
- .8 Curing compound: clear, water-based, low-VOC curing compound conforming to ASTM C309 as manufactured by CPD, Euclid, WR Meadows or Sika.
  - .1 Concrete Curing Compounds: maximum VOC limit 100 g/L in accordance with SCAQMD Rule #1113.
- .9 Polyethylene curing sheet shall be a minimum of 0.05 mm (2 mil) thick.
- .10 Saw-cut control joint fillers: as manufactured by CPD, Euclid, WR Meadows, Sika forming to:
  - .1 Type 1 interior non-vehicular areas: flexible 2-component epoxy/urethane material having a Shore "A" hardness of 25-35.
  - .2 Type 2 interior vehicular areas: semi-rigid polyurea or epoxy filler having a minimum Shore "A" hardness of 80.

## **2.2 ACCESSORIES**

- .1 Provide all concreting accessories as required for a complete installation.

## **Part 3 Execution**

### **3.1 GENERAL CONCRETING MATERIALS AND METHODS**

- .1 Provide sawcut control joints and perform all other concreting work in accordance with the requirements of this Section 03 35 10, CSA A23.1/CSA A23.2, the Drawings, and "Best Practices Guide for Concrete Construction", most recent published edition, published by the Ontario General Contractor's Association and the Ready Mixed Concrete Association of Ontario.
- .2 All concrete that will be exposed to view in the finished Work must have a consistent and uniform colour and appearance throughout, with no visible colour variations between pours or locations. Batching, curing, and finishing must be planned and executed accordingly.

### **3.2 CONCRETE PLACEMENT**

- .1 General Contractor shall ensure adequate temporary lighting as necessary for nighttime finishing requirements.
- .2 Inspect the granular base elevation for variations in excess of +/- 10 mm (3/8"). Report deviations to the General Contractor who is responsible to arrange for the rectification of any deficiencies observed.
- .3 Protect adjacent surfaces from damage or staining as required.
- .4 Install isolation joint for full slab thickness between free slab edges and perimeter walls wherever the concrete floor is not tied to the foundation wall with rebar.

- .5 If there are through-slab penetrations, wrap with foam isolation joint or form around penetrations with Sonotube for the full depth of the slab. Fill Sonotube infills with concrete after 28 days drying or after adjacent saw-cut control joints have cracked.
- .6 Slab thickenings may be pre-poured to reduce drying shrinkage cracking with the approval of the owner.
- .7 Install welded wire mesh above the granular base elevation and below the depth of the sawcut control joints.
- .8 Place, finish and cure concrete in accordance with CSA A23.1.
- .9 Slabs-on-ground shall be constructed to comply with CSA A23.1 thickness tolerances.

### **3.3 FINISHING FLOORS AND SLABS**

- .1 Finish floors and slabs in accordance with CSA A23.1 and ACI 302.1 recommendations for screeding, re-straightening, and finishing operations for concrete surfaces; do not wet concrete surfaces.
- .2 Float (Initial) Finishing:
  - .1 Consolidate surface with power driven floats or by hand floating if area is small or inaccessible to power driven floats.
  - .2 Re-straighten, cut down high spots, and fill low spots.
  - .3 Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
  - .4 Apply float finishing to interior concrete floor slab surfaces, and as noted on Drawings.
- .3 Trowel (Final) Finishing:
  - .1 Commence trowel finishing after all bleed water has disappeared and when the concrete has stiffened sufficiently to prevent the working of excess mortar to the surface.
  - .2 Apply first trowelling and consolidate concrete by power-driven trowel (only use hand trowel where power-driven trowel cannot be used) after applying float finishing; continue trowelling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance; repair or smooth any surface defects that would telegraph through applied coatings or floor covering.
  - .3 Apply a trowel finishing to interior concrete floor slab surfaces, and as noted on Drawings.
  - .4 Finish surfaces to the tolerances indicated above.
- .4 Trowel and Fine Broom Finishing:
  - .1 Apply trowel and fine broom finishing to surfaces where ceramic or porcelain tile is scheduled for installation by either thickset or thin-set method.
  - .2 Slightly scarify surface with a fine broom while concrete is still plastic.
  - .3 Finish surfaces to the tolerances indicated above.
- .5 Broom Finishing:
  - .1 Apply a broom finishing to exterior concrete sidewalks, platforms, steps, and ramps, and elsewhere as indicated.
  - .2 Slightly roughen trafficked surface by brooming with fibre bristle broom perpendicular to main traffic route immediately after float finishing.
  - .3 Coordinate required final finishing with Consultant before application.
- .6 Sandblast Finishing:



- .1 Location: at surfaces to receive concrete sealer.
- .2 Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces to provide level[s] of finish as follows:
  - .1 Brush Blast Finish: Removes surface dirt and stains to give the surface a uniform appearance, but does not expose aggregate.

### 3.4 TOLERANCES

- .1 Minimum concrete slab surface hardness required: 7 Mohs, when tested to ASTM C1895. Provide inspection and testing as required to confirm that this requirement has been met before commencing floor preparation and finishing operations.
- .2 F-Number flatness and levelness surface tolerances shall be made in accordance with CSA A23.1 and shall be measured within 72 hours of each floor placement.
  - .1 Slabs shall meet the following overall F-Number tolerances in accordance with CSA A23.1, as follows:
    - .1 Interior slabs-on-ground and patio: F<sub>F</sub>25 x F<sub>L</sub>20; similar to CSA A23.1 Class B Slab Finishing.
    - .2 All other slabs: F<sub>F</sub>20 x F<sub>L</sub>15. similar to CSA A23.1 Class A Slab Finishing.
    - .3 Final leveling materials and work required to suit floor finish to be applied shall be supplied and performed by the relevant trades.

### 3.5 TREATMENT AT MECHANICAL CLEANOUTS

- .1 Treatment of Mechanical Cleanouts: At locations of mechanical cleanouts, coordinate as required to ensure cleanout cap is flush and even with adjacent concrete slab top surface. Where the adjacent slab is scheduled to have a floor finish covering (e.g., tile), cut and shape a patch made from the same floor covering material and adhere to cap in a manner that renders the cleanout cap location nearly invisible and fully blended in with adjacent flooring. Coordinate and cooperate with related trades as required to ensure compliance with this requirement.
  - .1 At polished concrete areas: cleanout cap shall be smooth and finish-painted colour and sheen that blends with adjacent polished concrete flooring colour and sheen to provide a near invisible cleanout cap. Apply concrete stain-resistant finish over paint as per Section 03 35 44 – Refined Concrete Finishing.

### 3.6 NON-CONFORMING WORK

- .1 Inspect surfaces for defects immediately after removal of forms. Repair or patch defects within 48 hours of removal of forms with cured repairs to match appearance, colour and texture of adjacent new concrete.
- .2 Defective Areas: where patches are allowed, repair and patch areas to match surrounding areas in appearance, colour and texture.

### 3.7 CONCRETE CURING

- .1 All surfaces shall be cured commencing as soon as possible after final finishing. Surfaces shall be wet cured, as follows:
  - .1 Wet Curing - apply water to the slab surface and cover with polyethylene, burlap or geotextile fabric.
    - .1 Keep continuously wet for a minimum of 3 days for basic curing period.
    - .2 Floors subject to forklift traffic shall be wet cured for an additional 4 days.

- .3 Bonded toppings shall be continuously wet cured for 7 days with a further 7-day protection period from injurious shock or vibration.

### **3.8 CONTROL JOINTS IN SLABS-ON-GROUND**

- .1 Sawcut control joints shall be installed as per the structural design Drawings, and conforming to with CSA A23.1. Cutting shall commence as soon as possible without damaging the concrete. Fill with a flexible material like a self-leveling polyurethane sealant or a 2-part epoxy gel – use same fill material throughout for consistency unless changes are required to meet flooring compatibility requirements.
- .2 Fill exposed joints subject to vehicular traffic full depth with a load bearing semi-rigid polyurea or epoxy filler (without backer rod) after a minimum 120 days air drying at 20°C. Fill exposed joints subject to foot traffic, with a flexible epoxy/urethane sealant 13 mm (1/2") deep on a backer rod after a minimum 75 days air drying at 20°C. Fill joints in freezer floors only after the slab has stabilized at operating temperatures.
- .3 Coordinate joint fill material selection with other trades as required to ensure compatibility of joint treatments with applied flooring products, such as tile and fluid applied flooring. Where compatibility concerns exist, the flooring trade will supply and install the appropriate joint fill material compatible with the flooring material to be installed.

### **3.9 ISOLATION, CONSTRUCTION AND EXPANSION JOINTS**

- .1 Refer to and coordinate with the civil and structural design Drawings.
- .2 Provide isolation, construction and expansion joints as noted on the structural design Drawings and civil design Drawings.
- .3 Install joint fillers in joints as required in accordance with the joint filler manufacturer's published installation instructions, data sheets and specifications.

### **3.10 CONCRETE SEALERS**

- .1 Seal concrete as indicated, to Section 03 05 10 – Concrete Sealers.

### **3.11 POLISHED CONCRETE**

- .1 Polish concrete as indicated, to Section 03 35 44 – Refined Concrete Finishing.

### **3.12 STAMPED CONCRETE**

- .1 Stain concrete at patio slab-on-ground and apply patterned imprint, to Section 03 35 33 – Stamped Concrete Finishing.

### **3.13 FIELD QUALITY CONTROL**

- .1 Non-conforming work shall be repaired to meet the specified requirements.
  - .1 Measure first pour tolerances and continue as necessary to ensure conformance to specified tolerances.
- .2 Tests shall be made in accordance with CSA A23.2.
- .3 Air entrainment and slump testing shall be from the same sample of concrete as the compressive strength cylinders.
- .4 Materials and workmanship shall be inspected and tested in conformance with CSA A23.1 and CSA A23.2 by an independent inspection company selected and paid for by the Owner.

- .5 There shall be full time inspection on each concrete floor placement. Inspection reports shall be forwarded to the Owner's representative, the general contractor and the concrete floor contractor. Inspectors shall report any deviations or variations on site immediately to allow for corrective action.
- .6 Inspection to include for the following:
  - .1 Verification of benchmark with finished floor elevation.
  - .2 Verification of granular base elevation and slab thickness.
  - .3 Compaction of granular base, which must be minimum 98% SPD, compacted in layers, to ASTM D698.
  - .4 Elevation of drains and cleanouts.
  - .5 Elevation changes for sloping floors in relation to drainage.
  - .6 Inspect placement of reinforcing bars including grade, size, spacing and elevation.
  - .7 Use of specified materials and dosage or application rates.
  - .8 Concrete delivery tickets including water-to-cement ratio, compressive strength, slump and air content at the point of concrete placement. For surfaces to receive a machine trowel finish, the first load of concrete for each placement shall be tested for its plastic air content, which shall not exceed 3%.
  - .9 Concrete compressive strength and plastic air content as per CSA A23.1.
  - .10 Curing regime.
  - .11 Joint layout.
  - .12 Joint filler depth.
  - .13 Concrete surface hardness: must be minimum 7 Mohs, when tested to ASTM C1895; this requirement pertains to floor areas to be sealed, polished or have a fluid applied coating installed.
  - .14 Verification of slab thickness.
  - .15 Verifications that F-number floor tolerances for flatness (F) and levelness (L) have been met as measured within 72 hours of placement.
- .7 Testing to include the following at the discretion of the Owner:
  - .1 Concrete drying shrinkage testing.

### **3.14 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.15 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.16 MAINTENANCE**

- .1 Provide training to Owner's representative based on manufacturer's written instructions as indicated in Section 01 79 00 - Demonstration and Training.

**3.17 SCHEDULE**

- .1 Refer to Drawings: polished concrete at the office areas, to Section 03 35 44 Refined Concrete Finishing; sealed concrete at the service areas, to Section 03 05 10 – Concrete Sealers; two-component aliphatic polyurethane flooring at the firetruck bays, to Section 09 67 00 Fluid Applied Flooring; coloured stamped concrete at the exterior concrete patio per landscape Drawings and Section 03 35 33 – Stamped Concrete Finishing.
- .2 Refer to Drawings for other concreting and floor finish requirements.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Section 03 35 10 – Concrete Floor and Slab Finishing.
- .3 Section 07 92 00 – Joint Sealants.

**1.2 REFERENCES**

- .1 American Concrete Institute (ACI):
  - .1 ACI 302.1R-15, Guide for Concrete Floor and Slab Construction.
- .2 ASTM International (ASTM)
  - .1 ASTM D92-24b, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester.
- .3 CSA International (CSA)
  - .1 CSA A23.1:24/A23.2:24, Concrete materials and methods of concrete construction/Test Methods and Standard Practices for concrete.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meeting: arrange a meeting attended by Contractor, trade contractor and Consultant prior to beginning Work of this Section, and discuss issues governing installation of concrete staining materials, including work sequencing and coordination. Obtain clear direction from the Consultant about the desired outcome and expected effects of concrete stain application.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals shall meet the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Product Data
  - .1 Submit manufacturer's printed product literature, specifications, and technical datasheet for each product specified.
  - .2 Submit printed installation instructions for concrete floor treatments.
  - .3 Submit copies of purchase orders and packing slips indicating the quantity of materials required for the project and include a copy of the manufacturer's recommended coverage rate.
- .3 Submit detailed cleaning and maintenance instructions for stain and concrete sealer products and instruct Owner in proper care and maintenance of specified floor finishes, including a complete list of floor care products that will be required for on going maintenance.
- .4 Submit closeout data in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions and submit a complete list of floor care products that will be required for on-going maintenance.

**1.5 QUALITY ASSURANCE**

- .1 Refer to and comply with the requirements of Section 03 35 10 - Concrete Floor and Slab Finishing, item **1.6 QUALITY ASSURANCE**.

- .2 Concrete finishing work to generally conform to CSA A23.1, and as modified by this Section.
- .3 Work that is found to be below the minimum acceptable standards established by CSA A23.1 and this specification shall be demolished and rebuilt or repaired as directed by the Consultant at no additional cost to Contract.

## **1.6 WARRANTY**

- .1 Contractor agrees to correct any deficiencies found in the work performed for a period of 2-years from date of Substantial Performance.
- .2 Provide manufacturer's standard limited warranty.

## **Part 2 Products**

### **2.1 GENERAL CONCRETING METHODS AND MATERIALS**

- .1 Meet the requirements of Section 03 35 10 – Concrete Floor and Slab Finishing.

### **2.2 CONCRETE FINISHING – GENERAL**

- .1 Meet the requirements of Section 03 35 10 – Concrete Floor and Slab Finishing.

### **2.3 MATERIALS**

- .1 Patterned imprint stamp mats/skins:
  - .1 Standard of Acceptance:
    - .1 Artevia™ Stamp, by LaFarge Canada
  - .2 Imprint Pattern: large ashlar slate.
  - .3 Stamp Release agent: as recommended by mat/skin manufacturer.
- .2 Stained Concrete Finish:
  - .1 Standard of Acceptance:
    - .1 Artevia™ line of stains, by LaFarge Canada
  - .2 Colour: Artevia™ Pearl Beige (SRI 31).
- .3 Penetrating Concrete Sealer: 100% active hydrophobic silane monomer solution which penetrates deep into the concrete substrate to create a hydrophobic layer within the matrix as well as on the surface; single-component, solvent-free, low-VOC material.
  - .1 Standard of Acceptance:
    - .1 SOLHYDSEAL 100, by LaFarge Canada, BMQ Solutions.

### **2.4 ACCESSORIES**

- .1 Protection Mat: breathable mat to protect finished work.
  - .1 Ram Board Plus®, by Ram Board, Inc., plus manufacturer's recommended accessories, or equivalent, or equivalent.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections are in accordance with stamped concrete manufacturer's recommendations.
  - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
  - .3 Starting application of stamped concrete finishing implies substrate conditions are acceptable for Work of this Section.

**3.2 STAMPED CONCRETE**

- .1 Stamp concrete in accordance with manufacturer's published instructions.

**3.3 CONCRETE STAINING**

- .1 Cure concrete to allow concrete to become reactive, minimum 60 days.
- .2 Thoroughly clean concrete in accordance with manufacturers written instructions and prepare concrete in accordance with manufacturers written instructions. Allow floor to dry completely prior to application of floor stain.
- .3 Divide surfaces into small work sections using wall, joint lines, or other stationary breaks as natural stopping points.
- .4 Tape over elements not to be stained, protecting such surfaces from stain material.
- .5 Prepare surfaces and apply products in accordance with manufacturer's published technical specifications, data sheets, and approved mock-up.
  - .1 Apply two coats of chemical stain materials; obtain Consultant's review after application of both first and second coats; adjust application rate of second coat to meet Consultant's acceptance for final coat.
  - .2 After initial cure, apply concrete sealer in accordance with sealer manufacturer's published application instructions.
- .6 Provide Owner with maintenance instructions and list of products required to clean and refresh floor surface.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.6 DEMONSTRATION AND TRAINING**

- .1 Train Owner's designated maintenance personnel in the care and upkeep of polished and slip resistant concrete finishes, based on written maintenance instructions provided in accordance with Section 01 79 00 - Demonstration and Training.

**3.7 SCHEDULE**

- .1 Install stained stamped concrete at patio in accordance with the landscape design Drawings.

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 Section specifies requirements for polished concrete

**1.2 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Section 03 35 10 – Concrete Floor and Slab Finishing.
- .3 Section 07 92 00 – Joint Sealants.

**1.3 REFERENCES**

- .1 American Concrete Institute (ACI)
  - .1 ACI 117-10 (R2015), Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary-Reapproved 2015.
  - .1 ACI 117.1R-14, Guide for Tolerance Compatibility in Concrete Construction.
  - .2 ACI 301-20, Specification for Concrete Construction.
  - .3 ACI 302.1R-15, Guide for Concrete Floor and Slab Construction.
- .2 The American Society of Mechanical Engineers (ASME)
  - .1 ASME B46.1-2019, Surface Texture (Surface Roughness, Waviness, and Lay).
- .3 ASTM International (ASTM) ASTM C1895-20
  - .1 ASTM C779/C779M-19, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
  - .2 ASTM C1895-20, Standard Test Method for Determination of Mohs Scratch Hardness.
  - .3 ASTM D4039-09(2023), Standard Test Method for Reflection Haze of High-Gloss Surfaces.
  - .4 ASTM D5767-18(2023), Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces.
- .4 CSA Group
  - .1 CSA A23.1:24/CSA A23.2:24, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
  - .2 CAN/CSA A23.3:24, Design of concrete structures.
- .5 National Floor Safety Institute (NFSI)
  - .1 NFSI B101.1-2022: Measuring the Wet SCOF of Walkways.
  - .2 NFSI B101.3-2022: Testing Wet DCOF Of Hard Surface Walkways.
  - .3 NFSI B101.4-2023: Standard Test Method for Measuring the Wet Barefoot Condition of Walking and Bathing Surfaces.

**1.4 DEFINITIONS**

- .1 Aggregate Exposure Class: Depth of grind to achieve required appearance as follows:
  - .1 Cream: Minimal surface cut with little or no aggregate exposure.
  - .2 Fine Aggregate: 1.5 mm surface cut with salt and pepper appearance arising from fine aggregate exposure with little or no medium aggregate exposure and random locations.

- .3 Medium Aggregate: 3 mm surface cut with predominately medium aggregate showing, some fine aggregate, and little or no large aggregate exposure at random locations.
- .4 Large Aggregate: 6 mm surface cut with predominately large aggregate showing and little or no fine aggregate at random locations.
- .2 Sheen of Polished Concrete Surfaces: shall be determined by measuring and achieving the specified average surface roughness (Ra) when tested to ASME B46.1 as follows:
  - .1 Newly placed concrete finish: Ra of 2.54µm.
  - .2 Matte: Ra of 0.76µm.
  - .3 Semigloss: Ra of 0.50µm.
  - .4 Glossy: Ra of 0.254µm.
  - .5 Acceptable tolerance for variation from specified average roughness (Ra): ±0.127µm.

#### **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Convene pre-installation meeting one week prior to beginning work of this Section, with Contractor, Consultant, and installer to:
  - .1 Identify locations for mock-ups.
  - .2 Review manufacturer's installation instructions.
  - .3 Ensure clear understanding of desired outcomes and expected effects.

#### **1.6 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submittals shall meet the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Submit product data:
  - .1 Submit manufacturer's published product literature, specifications and data sheet for the following:
    - .1 Grinding and polishing machine.
    - .2 Types of grinding heads.
    - .3 Dust extraction.
    - .4 Water control and concrete densifier materials.
    - .5 Application instructions.

#### **1.7 CLOSEOUT SUBMITTALS**

- .1 Submit closeout data in accordance with Section 01 78 00 – Closeout Submittals.
  - .1 Provide manufacturer's published recommendations for general maintenance, including cleaning instructions and submit complete list of floor care products required for on-going maintenance.

#### **1.8 QUALITY ASSURANCE**

- .1 Refer to and comply with the requirements of Section 03 35 10 - Concrete Floor and Slab Finishing, item **1.6 QUALITY ASSURANCE**.
- .2 Concrete Polishing Subcontractor Qualifications: Use an experienced and certified concrete finisher with a minimum of 10 projects performed within 3 years of similar type, size and complexity as this project.

**1.9 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store, and handle materials in a manner that prevents damage. Protect adjacent surfaces from damage resulting from the work of this Section.

**1.10 SITE CONDITIONS**

- .1 Ensure that the building envelope adequately protects concrete from damage caused by wind, rain, high temperatures, freezing or snow damage. Do not use open flame heaters. Ensure adequate fresh air ventilation.
- .2 Comply with manufacturers' published instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting performance.
- .3 Concrete must be cured a minimum of 45 days or as directed by manufacturer before application can begin, and have the specified surface hardness.
- .4 Do not commence with installation until Work yet to be performed will not adversely affect installation of flooring treatments.
- .5 Limit and control excessive dust caused by grinding/polishing procedure.

**1.11 WARRANTY**

- .1 Polished concrete floor shall have an extended warranty against surface deterioration, dusting and cracking for a period of two (2) years from the date of Substantial Performance of the Work.

**Part 2 Products**

**2.1 PERFORMANCE REQUIREMENTS AT POLISHED CONCRETE FLOOR AREAS**

- .1 Required gloss level: 'Semigloss', having an average surface roughness (Ra) of 0.50µm, to ASME B46.1; provide uniform average surface roughness across polished floor areas as required to achieve continuity and uniformity of appearance. Provide inspection and testing as required to confirm that this requirement has been met.
- .2 Aggregate exposure: 'Cream', uniform and consistent appearance across all exposed polished concrete surfaces.
- .3 Minimum concrete slab surface hardness required before commencing polished concrete procedures: 7 Mohs, when tested to ASTM C1895. Provide inspection and testing as required to confirm that this requirement has been met before commencing grinding and polishing operations. Coordinate with other trades as required to ensure compliance.
- .4 Dynamic Coefficient of Friction (DCOF) when tested to ANSI/NFSI B101.1: a DCOF of 0.42 or greater is required, and must be uniform across all polished floor areas. Provide inspection and testing as required to confirm that this requirement has been met.

**2.2 GENERAL CONCRETING METHODS AND MATERIALS**

- .1 Meet the requirements of Section 03 35 10 – Concrete Floor and Slab Finishing.

**2.3 CONCRETE FINISHING – GENERAL**

- .1 Meet the requirements of Section 03 35 10 – Concrete Floor and Slab Finishing.

## **2.4 MANUFACTURERS**

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
  - .1 RetroPlate Canada.
  - .2 W.R. Meadows Inc., Induroshine.
  - .3 L&M Permashine.

## **2.5 EQUIPMENT**

- .1 Equipment to be used for grinding/polishing shall be as recommended by product manufacturer to achieve finish specified and as follows:
  - .1 Three head counter rotating variable speed floor grinding machine.
  - .2 Possesses at least 352 kg of head pressure.
  - .3 Equipped with dust extraction system.
- .2 Diamond grinding segments shall be:
  - .1 Metal bonds: use progressively finer grit stages to achieve 'Cream' exposure class. Appearance must be uniform and consistent at all treated areas.
- .3 Diamond polishing pads shall be:
  - .1 Resin bonds: use progressively finer grit stages to achieve the average surface roughness (Ra) specified for a 'Semigloss' finish.
- .4 Grinding pads for edges shall be:
  - .1 Resin bonds: use progressively finer grit stages to achieve the average surface roughness (Ra) specified for a 'Semigloss' finish.
- .5 Equipment to be used for densifying and cleaning the floor after grinding/polishing procedure has been performed:
  - .1 Ride-on auto-scrubber, by Tennant Company, or equivalent with a head pressure of 68 kg.
  - .2 Follow auto-scrubber's manual for cleaning instructions after densifying and conditioning the floor.
  - .3 Do not allow densifier to remain inside the auto-scrubber after densifying.

## **2.6 MATERIALS**

- .1 Concrete Densifier: water-based, odourless and colourless liquid, VOC compliant, environmentally safe chemical hardening solution leaving no surface film in accordance with Section 03 35 00 – Concrete Finishing.
  - .1 Acceptable Materials:
    - .1 RetroPlate System, Advanced Floor Products.
    - .2 Pentra-Sil NL, Convergent Concrete.
    - .3 Mapecrete Hard LI, Mapei
    - .4 Liquihard, W.R. Meadows Inc.
- .2 Stain Resistant Finish: Proprietary stain-resistant finish/conditioner as recommended by concrete polishing fabricator.
  - .1 Acceptable Materials:
    - .1 RetroPlate System, Advanced Floor Products.

- .2 Pentra Finish, Convergent Concrete.
- .3 Mapecrete Protector FF, Mapei
- .4 Bellatrix, W.R. Meadows Inc.
- .3 Patching Compound: Manufacturers compatible cementitious compound coloured and textured to match adjacent polished concrete surfaces so patching is invisible.
  - .1 Standard of Acceptance:
    - .1 Ultratop, Mapei.

## **2.7 TEMPORARY FLOOR PROTECTION**

- .1 Ram Board Plus®, by Ram Board, Inc., plus manufacturer's recommended accessories, or equivalent.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine surfaces to receive treatment. Notify Consultant if surfaces are not acceptable. Do not begin application until unacceptable conditions have been corrected.
- .2 Test concrete surfaces to be treated, to ASTM C1895, to verify that the surface hardness of the concrete is 7 Mohs.

### **3.2 SURFACE PREPARATION**

- .1 Protect adjacent surfaces not designated to receive treatment.
- .2 Clean and prepare surfaces to receive treatment in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, dust and dirt are removed prior to application.
- .3 Ensure concrete is a minimum of 45 days old.
- .4 Fill saw cut control joints with manufacturer recommended joint filler to prevent spalling and chipping of joint edges.

### **3.3 FLOOR POLISHING: SEMI-POLISHED FINISH**

- .1 Polish and grind concrete floors in accordance with manufacturer's instructions as required to achieve the specified average surface roughness (Ra) of 0.50µm, as measured to ASME B46.1.
- .2 Grind floors at a rate as recommended by manufacturer using progressively finer grit stages to achieve 'Cream' exposure class. Vacuum surfaces between grinding stages to remove loose particles.
- .3 Flood surface with concrete densifier and scrub into floor for 45 minutes, ensuring that no puddling of densifier occurs.
- .4 Squeegee off excess material and allow minimum 24 hours to dry.
- .5 Verify that the floor is dry and clear of debris prior to continuation of polishing procedure.
- .6 Modify the following grinding stages as required to ensure the specified average surface roughness is achieved and uniform at all treated floor areas. Monitor and test frequently as required to ensure compliance.
  - .1 Grind floor at a rate of 56 m<sup>2</sup>/hr using 100-grit resin bond polishing segment. If scratches from the previous grit are still apparent, decrease the rate of grinding

- by 9 m<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
- .2 Grind floor at a rate of 65 m<sup>2</sup>/hr using 200-grit resin bond polishing segment. If scratches from the previous grit are still apparent, decrease the rate of grinding by 9 m<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
- .3 Grind floor at a rate of 65 m<sup>2</sup>/hr using 400-grit resin bond polishing segment. If scratches from the previous grit are still apparent, decrease the rate of grinding by 9 m<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
- .4 Grind floor at a rate of 93 m<sup>2</sup>/hr using 800-grit resin bond polishing segment. If scratches from the previous grit are still apparent, decrease the rate of grinding by 9 m<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
- .5 Grind floor at a rate of 139 m<sup>2</sup>/hr using 1200-grit resin bond polishing segment. If scratches from the previous grit are still apparent, decrease the rate of grinding by 9 m<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
- .6 Test the average surface roughness (Ra) of the floor. If the floor is still too rough, proceed to the following stage, but do not over-polish:
  - .1 Grind floor at a rate of 139 m<sup>2</sup>/hr using 1500-grit resin bond polishing segment. If scratches from the previous grit are still apparent, decrease the rate of grinding by 9 m<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
- .7 Ensure the finished work is uniform across all floor areas polished.
- .8 Clean floor thoroughly as per manufacturer's instructions.

### **3.4 CONCRETE STAIN RESISTANT FINISH**

- .1 Allow 24 hours before proceeding with application of stain resistant finish.
- .2 Apply concrete stain resistant finish according to manufacturer's instructions.

### **3.5 PATCHING POLISHED CONCRETE**

- .1 Conserve grinding debris from area for use as component in patching materials; mix grinding debris with patching compound to achieve colouration and surface appearance similar to adjacent surfaces.
- .2 Patch tear outs and edge spalling using manufacturer's patching compound compatible with concrete polishing materials and methods.

### **3.6 FILED QUALITY CONTROL**

- .1 Perform the following inspections and tests as required to verify that specification have been met and are uniform and continuous across all treated floors; refer to the requirements of Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
  - .1 Test finished floors as required to verify that the average surface roughness (Ra) of 0.50µm), to ASME B46.1, and been achieved and is uniform and continuous across all polished floors.
  - .2 Test the polished floors for Dynamic Coefficient of Friction (DCOF), to ANSI/NFSI B101.1, as required to verify that they have a DCOF of 0.42 or greater, and that the DCOF is uniform and consistent across all polished floors.

**3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.9 MAINTENANCE**

- .1 Train Owner's designated maintenance personnel in the care and upkeep of polished and slip resistant concrete finishes, based on written maintenance instructions provided in accordance with Section 01 79 00 – Demonstration and Training.

**3.10 SCHEDULE**

- .1 Refer to Drawings, and provide polished concrete finish at office areas, and as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 cast-in-place concrete.
- .2 Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.1 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A820/A820M-22 Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.
  - .2 ASTM C109/C109M-24, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
  - .3 ASTM C191-21, Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.
  - .4 ASTM C348-21, Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
  - .5 ASTM C1059/C1059M-24, Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
  - .6 ASTM D4263-24, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
  - .7 ASTM E90-23, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .8 ASTM E492-22, Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine.
  - .9 ASTM F710-22, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- .2 CSA Group (CSA)
  - .1 CSA A23.1:24/A23.2:24, Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
  - .2 CSA A23.3:24, Design of Concrete Structures.
  - .3 CSA A3000:23, Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .4 CAN/CSA S6:19 (R2024), Canadian Highway Bridge Design Code, Includes Update No. 1 (2016), Update No. 2 (2017).
  - .5 CAN/CSA S6.1:19, Commentary on CAN/CSA-S6:19, Canadian Highway Bridge Design Code.
  - .6 CAN/CSA S269.1-16 (R2021), Falsework and Formwork.

**1.2 MIX DESIGN**

- .1 Retain professional engineer registered in the Province of Ontario to determine mix design complying with the requirements of the Ontario building Code and amendments, CSA A23.1/CSA A23.2, CSA 23.3, CSA 3000, and the requirements of this Section:
  - .1 Certify that mix design proportions for each type of concrete specified will produce the specified strength and slump and comply with the cement strength specified in this section.



- .2 Certify that plant, equipment and materials used in concrete comply with requirements of CSA A23.1.
- .3 Certify that concrete mix design will provide specified strength in accordance with the requirements of CSA A23.1.
- .4 Certify that the delivered concrete complies with the reviewed mix design and the specified performance criteria prior to placing on site.
- .5 Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- .6 Indicate amounts of mix water to be withheld for later addition at Project site.

### **1.3 CONCRETE TESTING**

- .1 Inspection and testing of concrete and concrete materials shall be paid for by the Contractor by testing agencies agreed upon by the Owner and the Consultant.
- .2 Coarse aggregates shall be tested for susceptibility to D-cracking unless their performance history is known. Test data or field performance data for comparable aggregates from the same quarry are acceptable for this purpose. The following test method is acceptable: AASHTO T 161 (ASTM C666), extended to 350 cycles; the durability factor is calculated from the expansion of the specimens.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit to Section 01 33 00 - Submittal Procedures.
- .2 Engage the services of a structural Professional Engineer (P.Eng.), licenced to practice in the Province of Ontario, for the concrete mix design, formwork and reinforcement and control joint detailing of the new concrete slabs at the entrance thresholds. The design shall conform to regulatory requirements and the requirements of this Section.
- .3 Submit 5-copies of design mixes for each concrete mix required for the project. Design mix will be distributed to the Consultant, the Owner, the Contractor, and the Testing Agency.
- .4 Shop Drawings:
  - .1 Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and necessary details of reinforcing.
  - .2 Submit drawings showing formwork and falsework design to: CSA A23.1/A23.2.
  - .3 Submit drawings stamped and signed by professional engineer licensed to practice in Province of Ontario, Canada.
  - .4 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .5 At least 4-weeks prior to beginning Work, submit to Consultant samples of following materials proposed for use:
  - .1 Expansion joint.
- .6 Concrete hauling time: provide for review Consultant deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

### **1.5 QUALITY ASSURANCE**

- .1 Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

- .2 All concrete supplied for this Contract shall be concrete ready-mix as supplied by a local ready-mix plant certified by Concrete Ontario.
- .3 Comply with CSA A23.1/A23.2 and CSA A3000, including the following, unless modified by the requirements of the Contract Documents:
  - .1 General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
  - .2 Formwork and form accessories.
  - .3 Reinforcement and supports: to ASTM D7957/D7957M.
  - .4 Concrete mixtures.
  - .5 Handling, placing, and constructing concrete.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements:
  - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
    - .1 Do not modify maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2.
    - .2 Deviations to be submitted for review by the Consultant.
  - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

## **1.7 WARRANTY**

- .1 For the work of this Section, the 12-month warranty period prescribed in Contract is extended to 36-months.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Primers: concrete manufacturer's recommended materials for application to wood and concrete substrates.
- .2 Concrete Topping:
  - .1 Cement: Type GU.
  - .2 Compressive Strength at 28 days: 25 MPa.
  - .3 Air Content: none.
  - .4 Maximum Water/Cement Ratio: 0.5.
  - .5 Slump range: 80 mm.
  - .6 Maximum Aggregate Size: 20 mm.
  - .7 Mix Water: potable; free from impurities and from a domestic source.
  - .8 Steel fiber reinforced: dispersed uniformly at random in small percentages, i.e. between 0.3% and 2.5% by volume in plain concrete.
  - .9 Topping thickness: refer to Drawings.

## **2.2 STANDARDS**

- .1 Cement: to CSA A3001, Type GU.
- .2 Air Entraining Admixture: CAN/CSA A23.1/A23.2 and ASTM C260.
- .3 Water: to CSA A23.1/A23.2.
- .4 Aggregate: to CSA A23.1/A23.2, containing no shale.
- .5 Fiber reinforcement: to ASTM A820/A820M.
- .6 Furnish formwork and form accessories to CSA A23.1.

## **2.3 ACCESSORIES**

- .1 Expansion Joint Fillers: to Section 03 35 10 - Concrete Floor and Slab Finishing.
- .2 Isolation Joint Fillers: to Section 03 35 10 - Concrete Floor and Slab Finishing.
- .3 Concrete Curing Agent: chlorinated-rubber-based curing agent and guaranteed by the manufacturer to be compatible with specified subsequent finishes.

## **2.4 CONCRETE MIXING**

- .1 Ready Mixed Concrete: Comply with CSA A23.1.
- .2 When air temperature is between 30° and 32°C, reduce mixing and delivery time from 1½ hours to 75 minutes; when air temperature is above 32°C, reduce mixing and delivery time to 60 minutes.

# **Part 3 Execution**

## **3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that substrates are structurally sound and dry, and free of deleterious materials before beginning installing products specified in this Section.
- .2 The structural subfloor and floor joist must comply with manufacturers' maximum span criteria, and meet or exceed the floor deflection requirements of all floor finishes.
- .3 Installation of products specified in this Section will denote acceptance of site conditions.

## **3.2 COORDINATION**

- .1 Coordinate with other trades as required.

## **3.3 PREPARATION**

- .1 Building interior should be enclosed and maintained at a temperature above 50°F (10°C) until structure and subfloor temperatures are stabilized. The subfloor must be broom clean and contaminant free.
- .2 Before pouring Concrete topping, the subfloor must be coated with a primer approved by the concrete supplier.
- .3 Surface Preparation:
  - .1 Leak Prevention: Fill cracks and voids in slab/deck substrates using manufacturers recommended quick-setting patching materials.
  - .2 Priming: Prime substrates in accordance with manufacturer's recommendations using materials appropriate to site conditions.

### **3.4 INSTALLATION**

- .1 Priming:
  - .1 Prime the properly prepared substrate with manufacturer's recommended primer to ensure maximum adhesion of floor topping.
  - .2 Apply floor topping according to manufacturer's recommendations at a rate recommended by primer manufacturer using a roller or garden-type sprayer.
  - .3 For very porous substrates, comply with primer manufacturer's guidelines.
  - .4 Ensure primer does not puddle or pool.
  - .5 Allow primer to completely dry.
- .2 Mixing:
  - .1 Mix only complete bags.
  - .2 Mix 5.5-6.5 qt. of potable water per 50-lb. bag of floor topping powder.
  - .3 Add required amount of water to the mixing vessel.
  - .4 Slowly add the powder while mixing with a combination high speed, heavy-duty drill (minimum 650 rpm) and Jiffy (PS-2 type) paddle.
  - .5 Mix for 2-3 minutes or until homogenous and lump-free ensuring not to over mix.
- .3 Forming: Design, construct, erect, shore, brace, and maintain formwork according to CSA A23.1 and CAN/CSA S269.1.
- .4 Topping Installation:
  - .1 Slope to drain as required.
  - .2 Install in accordance with concrete topping manufacturer's published installation instructions and illustrations, and product specifications.
  - .3 The minimum thickness of the concrete topping shall be 1-1/2-inches (38 mm).
  - .4 Provide continuous ventilation and adequate heat as required to rapidly remove moisture from the area until the concrete topping is dry.
  - .5 The Contractor must supply mechanical ventilation and heat as required.
  - .6 Expansion joints in all types of work shall be brought through the concrete topping.
- .5 Curing:
  - .1 Ensure area is well ventilated and heated, if necessary, to remove any excess water during curing.
  - .2 Avoid relative humidity in excess of 70% if possible.
  - .3 Avoid rapid surface drying.

### **3.5 SITE QUALITY CONTROL**

- .1 Site Testing:
  - .1 Slump Test: Test concrete topping for slump once every 250 m<sup>2</sup> as it is being pumped using a 50 mm x 100 mm cylinder resulting in a patty size of 215 mm to 230 mm in diameter.
  - .2 Compression Strength Test: Prepare and test 3-moulded cube samples from each day's pour or once each 1000 m<sup>2</sup> poured in a day; test in accordance with ASTM C472.

**3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.8 SCHEDULE**

- .1 Install concrete topping as indicated; refer to Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 – Structural Metal Stud Framing.
- .2 Section 05 50 00 – Metal Fabrications.
- .3 Section 07 21 13 – Board Insulation.
- .4 Section 07 21 16 – Fibrous Insulation.
- .5 Section 07 92 00 – Joint Sealants.
- .6 Section 13 34 19 – Pre-engineered Metal Building RFQ.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A116-22, Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric.
  - .2 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .4 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  - .5 ASTM A641/A641M-19(2025), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - .6 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .7 ASTM A1011/A1011M-23, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
  - .8 ASTM A1064/A1064M-24, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - .9 ASTM C67/C67M-24, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
  - .10 ASTM C140/C140M-24a, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
  - .11 ASTM C144-24, Standard Specification for Aggregate for Masonry Mortar.
  - .12 ASTM C207-24, Standard Specification for Hydrated Lime for Masonry Purposes.
  - .13 ASTM C216-24, Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
  - .14 ASTM C270-25, Standard Specification for Mortar for Unit Masonry
- .2 CSA Group (CSA)
  - .1 CSA A23.1:24/A23.2:24, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
  - .2 CSA A165 SERIES-14 (R2024), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
  - .3 CAN/CSA A179-14 (R2024), Mortar and Grout for Unit Masonry.

- .4 CSA A370-14 (R2023), Connectors for Masonry.
- .5 CAN/CSA A371-14 (R2024), Masonry Construction for Buildings.
- .6 CSA A3000:23, Cementitious materials compendium.
- .7 CSA G30.18:21, Carbon steel bars for concrete reinforcement.
- .8 CSA S304:24, Design of Masonry Structures, Includes Update No. 1 (2015).

### 1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
  - .1 Coordinate lines, levels and coursing with work of other Sections.
  - .2 Obtain built-in items prior to start of this work.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor's representative, trade contractor, material supplier and Consultant in accordance with Section 01 32 16 – Construction Schedule to:
  - .1 Verify project requirements including specification and details for project.
  - .2 Confirm required mortar, grout and concrete testing; review batch control and grouting procedures.
  - .3 Coordination with related Work including, but not limited to, air/vapour membranes and insulation.
  - .4 Review cavity drainage requirements and methods for keeping mortar out of cavity spaces.
  - .5 Coordinate crack control measures.
  - .6 Review requirements for reinforcement at corners and wall intersections.
  - .7 Review membranes and membrane flashing materials and details used for construction.
  - .8 Confirm trowelled or tooled joints to concealed and exposed masonry faces.
  - .9 Review methods for controlling efflorescence during construction.
  - .10 Review hot and cold weather requirements.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and data sheet. Indicate masonry types, shapes, sizes, and textures.
  - .2 Cementitious Materials:
    - .1 Include brand, type, and name of manufacturer for site mixed mortar materials.
    - .2 Submit proposed mix proportions and sand analysis reports and compressive strength reports on the proposed mortar mix(es).
- .3 Shop Drawings:
  - .1 Submit shop drawings showing plans, elevations, sections and details.
  - .2 Show the details of construction, and connection to structure.

- .3 Show details of air and vapour control layers and transitions to adjacent construction which maintain continuity of performance.
- .4 The geotechnical engineer has recommended that the site be classified as "Site Class D" for structural design purposes in the absence of a site-specific dynamic analysis.
  - .1 Design, erect and install windows to meet OBC requirements for Class D seismic conditions, or as otherwise determined by a professional engineer (P.Eng.) licensed to practice in the Province of Ontario based on OBC calculations.
  - .2 The Shop Drawings shall be designed and prepared by a delegated design Professional Engineer (P.Eng.) licenced to practice in the Province of Ontario, to Section 01 35 01. All Shop Drawings must be sealed and signed by the delegated design P.Eng. Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .4 Submit samples:
  - .1 Provide three concrete brick units to show texture and colour variance of finish.
  - .2 Provide samples of masonry connectors, joint reinforcement, flashing, weeps, and vents.
  - .3 Provide two grout samples indicating colours to be used with each brick type.
  - .4 Obtain review comments from Consultant prior to ordering.
- .5 Submit Mill Certificates certifying that the Portland cement supplied to the job meets the low-alkali criteria specified.

## **1.5 QUALITY ASSURANCE**

- .1 Sole Source: obtain brick masonry from a single manufacturer for entire project. Obtain concrete masonry units from a single supplier for entire project.
- .2 Conform to CSA A371, except as modified by this specification.
- .3 The masonry contractor shall be a member in good standing of the Canadian Masonry Contractors' Association (CMCA) through a registered Chapter.
- .4 The masonry contractor shall have a minimum of 5 years of experience on projects of similar size and magnitude and shall provide continuous active supervision by a journeyman mason while masonry work is in progress.
- .5 Masonry work shall be performed by experienced, qualified journeyman masons under the direct and continual full-time supervision of certified masons.
- .6 Before starting masonry work, establish mix proportions based on the limitations set out in Table 2 of CAN/CSA A179.
- .7 Test laboratory prepared samples of the proposed mortar(s) for compressive strength in accordance with CAN/CSA A179, by a laboratory approved by the Owner. The Owner will pay for the initial cost of mortar testing. Any re-testing required as a result of the original test failing will be borne by the Contractor.
- .8 Connectors and joint reinforcement shall conform to CSA A370.
- .9 Miscellaneous masonry accessories and their use where not otherwise specified but shown or required for proper completion of the Work, shall conform to CSA A371.
- .10 Regulatory Requirements: Provide fire resistance rated materials and construction identical to those of assemblies with fire resistance ratings determined by ULC Listings.



## **1.6 MOCK-UPS**

- .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
- .2 Construct mock-up panel of unit masonry construction, 1200 mm wide x 1200 mm high in location acceptable to Consultant.
- .3 Construct mock-up to establish a standard of construction, workmanship, and appearance. Show reinforcement, masonry connectors, flashing, jointing, coursing, mortar, and masonry pattern, unit face alignment, texture, and colour.
- .4 Do not continue with work of this Section until Consultant has reviewed mock-up.
- .5 Acceptable mock-ups may remain as part of the work

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver masonry units on pallets or cubes, suitably protected from road grime and moisture absorption due to exposure to rain or melting snow.
- .2 Unload and store on dry, level areas.
- .3 Remove plastic wrappings from concrete masonry units and cover with waterproof coverings that will provide protection from the elements but allow for air circulation.
- .4 Deliver cement, lime, and mortar in dry condition with manufacturer's label intact and store under waterproof cover and protected from elements.

## **1.8 SITE CONDITIONS**

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
  - .1 Minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.
  - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
- .2 Provide adequate bracing for masonry during construction and until permanent lateral supports are in place.

## **1.9 WARRANTY**

- .1 Contractor agrees to correct any deficiencies of labour or material found in the work performed for a period of 5 years from the date of Substantial Performance.

## **Part 2 Products**

### **2.1 DELEGATED DESIGN REQUIREMENTS**

- .1 Have masonry construction designed by a professional engineer (P.Eng.) licensed to practice in the province of Ontario, to Section 01 35 01 - Delegated Design.
- .2 The fire station is classified as having a post-disaster importance factor, and must be designed and constructed to remain safe, functional and accessible after a disaster in accordance with the OBC criteria. The following requirements apply to the Work of this Section:
  - .1 Refer to CSA S304:24, Design of Masonry Structures.
  - .2 The prescriptive masonry veneer tie spacing given in CSA A370, cannot be used. The ties must be engineered by Contractor's delegated design professional engineer.

- .3 Unreinforced masonry is not permitted.
- .4 Reinforcement is required for all loadbearing and lateral load-resisting masonry, masonry at exterior cladding (excluding veneer), and certain partitions as per OBC criteria.
- .5 Composite and multi-wythe solid walls must have grouted collar joists and ties.
- .6 The empirical design method for masonry cannot be used – all masonry must be engineered.

## **2.2 CONCRETE BRICK**

- .1 Concrete Brick: to CSA A165.2.
  - .1 Type: Solid.
  - .2 Grade: I – Exposed to weather.
  - .3 Size: Actual dimensions, 90 mm deep x 79 mm high x 257 mm long, metric modular.
  - .4 Compressive Strength: 25 MPa.
  - .5 Texture: Smooth.
    - .1 Acceptable materials:
      - .1 Contempo PRP or CarboClave, by Brampton Brick Ltd.
      - .2 Colour: Onyx.
      - .3 or approved equivalent.
  - .6 Coursing: stacked.

## **2.3 CONCRETE UNIT MASONRY – BASE BID**

- .1 Standard Concrete Masonry Units: to CSA A165.1 and as follows:
  - .1 Standard Weight Block: H/15/A/M.
  - .2 Size: As indicated on Drawings, and as required to meet coursing requirements.
  - .3 Special shapes: provide bull-nosed units for exposed corners as indicated on Drawings. Lintels and bond beams are constructed using knock-out lintel units. Provide additional special shapes as indicated.
  - .4 Refer to Drawings for indication of where standard weight and semi-lightweight block is required; if not indicated, use standard weight. If clarification is required, ask Consultant for clarification in writing and wait for written response. If the term 'lightweight block' is used, this shall mean 'semi-lightweight block' for the purposes of this Contract.
- .2 Fire-rated concrete block units: to CSA A165 Series (CSA A165.1) and as follows:
  - .1 Classification: H/15/B/M, except as modified by fire resistance requirements.
  - .2 Concrete Composition: Type L<sub>2</sub>30S Concrete
  - .3 Fire Rating: as indicated on Drawings.
  - .4 Size: as indicated on Drawings.
  - .5 Special shapes: provide bull-nosed units for exposed corners as indicated on Drawings. Lintels and bond beams constructed using knock-out lintel units. Provide additional special shapes as indicated.
- .3 Material tests shall be supplied to the Consultant, and certified as representative of materials supplied to the job site. Such tests shall have been made within previous three months.

- .4 Protect concrete block against wetting prior to laying in walls. Cover tops of walls after erection to prevent rainwater or snow from entering wall system prior to closing-in of building.

## **2.4 CONCRETE UNIT MASONRY – ALTERNATIVE**

- .1 Concrete Masonry Units: to CSA A165.1 and as follows:
  - .1 CarboClave concrete unit masonry units, by Brampton Brick Limited.
  - .2 Locations: concrete unit masonry walls and partitions designated to remain exposed.
  - .3 Size: As indicated on Drawings, and as required to meet coursing requirements.
  - .4 Special shapes: provide bull-nosed units for exposed corners as indicated on Drawings. Lintels and bond beams are constructed using knock-out lintel units. Provide additional special shapes as indicated.
- .2 Material tests shall be supplied to the Consultant, and certified as representative of materials supplied to the job site. Such tests shall have been made within previous three months.
- .3 Protect concrete block against wetting prior to laying in walls. Cover tops of walls after erection to prevent rainwater or snow from entering wall system prior to closing-in of building.
- .4 Clear Liquid Moisture Repellent: general-purpose clear silane/siloxane water repellent and chloride screen suitable for concrete and masonry, including concrete block, and clay and concrete brick surfaces.
- .5 After general cleaning of installed concrete unit masonry, apply water repellent in accordance with manufacturer's published instructions. The surfaces to be treated require a "wet-on-wet" application method: 1) apply first application as specified by manufacturer, 2) let the first application penetrate for 5 to 10 minutes, and then 3) reapply as specified by manufacturer. Do not let any of the first application dry before making the second application. Less material will be required on the second application.
  - .1 Standard of Acceptance:
    - .1 PROSOCO® Saltguard®, or approved equivalent.

## **2.5 CONCRETE**

- .1 Concrete used in masonry work shall have a minimum compressive strength and properties as noted in the structural design Drawings.

## **2.6 MORTAR AND GROUT MATERIALS**

- .1 Mortar colour to be selected by Consultant.
- .2 Use same brands of materials, colour additive, and source of aggregate for entire project.
- .3 Cement:
  - .1 Portland Cement: to CSA A3000, "Type GU-LA" (Portland cement with a low-alkali content), gray colour.
    - .1 Use low VOC products in compliance with SCAQMD Rule 1168.
  - .2 Use Portland cement with a total content of alkalis not above 0.6 percent.
- .4 Aggregate: supplied by one supplier.
  - .1 Mortar sand to CAN/CSA A179; manufactured sand, washed, clean, sharp particles.
  - .2 Coarse aggregate: to CAN/CSA A179.

- .5 Water: clean and potable.
- .6 Lime: Hydrated lime to CAN/CSA A179, Type SA.
- .7 Mortar Mixes:
  - .1 Mortar for exterior masonry above grade:
    - .1 Loadbearing: type S based on proportion specifications.
    - .2 Non-Loadbearing: type N based on proportion specifications.
  - .2 Mortar for interior masonry:
    - .1 Loadbearing: type S based on proportion specifications.
    - .2 Non-Loadbearing: type N based on proportion specifications.
  - .3 Mortar for parapet and unprotected walls: type N based on proportion specifications.
  - .4 Pointing Mortar: type N based on proportion specifications.
  - .5 Parging mortar: type N to CAN/CSA A179.
  - .6 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: type M based on proportion specifications, to CAN/CSA A179
  - .7 Following applies regardless of mortar types and uses specified above:
    - .1 Mortar for grouted reinforced masonry: type S based on proportion specifications.
  - .8 Certification and proof of compliance is required. Random cube tests required for Quality Control.
- .8 Mortar Mixing:
  - .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.
  - .2 Mix mortar ingredients in accordance with CAN/CSA A179 in quantities needed for immediate use.
  - .3 Maintain sand uniformly damp immediately before mixing process.
  - .4 Do not use admixtures, including pigments, air entraining agents, accelerators, retarders, water repellent agents, or other admixtures; unless approved in writing by the Consultant.
  - .5 Do not use anti-freeze compounds including calcium chloride or chloride-based compounds.
  - .6 Use a batch type mixer in accordance with CAN/CSA A179.
  - .7 Stain Resistant Pointing Mortar: one part Portland cement, 1/8-part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate to 2 percent of Portland cement by weight.
  - .8 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
  - .9 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2-1/2 hours at temperatures under 10 degrees C.
- .9 Grout Mixes:
  - .1 Mortar joints at grouted reinforced masonry: type S based on proportion specifications.
  - .2 Grout: as noted on the structural design Drawings: minimum 28-day strength of 20 MPa, to CAN/CSA A179.

- .10 Grout Mixing:
  - .1 Mix batched and delivered grout in accordance with CSA A23.1 transit mixed.
  - .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA A179 coarse grout.
  - .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
  - .4 Do not use calcium chloride or chloride-based admixtures.
- .11 Mix Tests:
  - .1 Testing Mortar Mix:
    - .1 Test mortar to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA A179. Test prior to construction and during construction for:
      - .1 Compressive strength.
      - .2 Consistency.
      - .3 Mortar aggregate ratio.
      - .4 Sand/cement ratio.
      - .5 Water content and water/cement ratio.
      - .6 Air content.
      - .7 Splitting tensile strength
  - .2 Testing Grout Mix:
    - .1 Test grout to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA A179 for grout based on proportion specification. Test prior to construction and during construction for:
      - .1 Compressive strength.
      - .2 Sand/cement ratio.
      - .3 Water content and water/cement ratio.
      - .4 Slump.

## **2.7 FINISHES FOR STEEL MATERIALS**

- .1 Finish for all steel materials and products used and incorporated into the Work shall be hot dipped galvanized after fabrication.
  - .1 All hot dip galvanized steel shall be galvanized by the hot dip method after fabrication and provide a minimum 460 g/m<sup>2</sup> galvanized coating thickness per side, meeting ASTM A123, ASTM A153 Class B.

## **2.8 REINFORCED MASONRY**

- .1 Meet the requirements as noted on the structural design Drawings.
- .2 Provide vertically reinforced and grouted masonry in accordance with requirements of the structural design Drawings. Refer to the 'MASONRY WALL SCHEDULE' on the structural design Drawings for additional information.
- .3 Meet requirements of CSA S304.1 and CAN/CSA A371, except as otherwise indicated.
- .4 Grout for grouted masonry shall conform to the requirements of CSA S304.1. Grout for filling concrete masonry units shall be high slump course grout with a maximum aggregate size of 10 mm and slump of 200 mm. The minimum compressive strength of grout shall be as noted on the structural design Drawings. Submit mix designs for review to Consultant prior to start of construction.
- .5 Prior to start of work, an independent testing agency will test masonry materials in accordance with CSA S304.1 to confirm compressive strength.

- .6 Independent testing agency will carry out tests on a minimum of 6 prisms prepared using grout mix to confirm grout strength.
- .7 Independent testing agency will carry out field control test in accordance with Section 5.4 of CSA S304.1.

## **2.9 REINFORCEMENT**

- .1 Meet the requirements as noted on the structural design Drawings.
- .2 Bar reinforcement: Steel to CAN/CSA A371 and CSA G30.18, Grade 400R for reinforcing steel and be deformed hi-bond hard grade with minimum yield of  $F_y = 400$  MPa.
- .3 Horizontal reinforcing shall be as noted on the structural design Drawings.
- .4 Masonry Joint Reinforcement: In accordance with to CAN/CSA A371 and ASTM A496/A496M, with corrosion protection in accordance with CSA S304 and CSA A370, and as follows:
  - .1 Material and Corrosion Protection:
    - .1 Interior Walls: hot dip galvanized carbon steel.
    - .2 Exterior Walls: hot dip galvanized carbon steel.
  - .2 Wire Size for Side Rods: No. 9 or 3.7 mm diameter.
  - .3 Wire Size for Cross Rods: No. 9 or 3.7 mm diameter.
  - .4 Spacing of cross-rods, tabs, and cross-ties: at a maximum of 400 mm on centre.
  - .5 Lengths: A minimum of 3000 mm, with prefabricated corner and tee units.
- .5 Connectors: to CSA A370 and CSA S304 with hot dip galvanized corrosion protection.
- .6 Horizontal Joint Reinforcement:
  - .1 Use ladder type for grouted and reinforced walls and truss type for unreinforced walls.
  - .2 All joint reinforcement to be hot dipped galvanized. Reinforcement shall be lapped a minimum of 300 mm at all joints.
  - .3 Prefabricated corner and tee reinforcement shall be used at all wall intersections.
  - .4 Install reinforcement at first and second bed joints, 200 mm apart, immediately above lintels and below sills, and shall extend 600 mm beyond jamb.
  - .5 Place reinforcement as required to achieve 16 mm of mortar cover on exterior face of wall and 12 mm cover on interior face of wall.

## **2.10 TIES AND ANCHORS**

- .1 Meet the requirements as noted on the structural design Drawings. Seismic requirements: in accordance with Ontario Building Code.
- .2 Ties and anchors specified in this section shall be hot dip galvanized after fabrication and designed in accordance with CSA A370 for non-conventional masonry connectors as follows:
  - .1 Deflection: Maximum 2 mm, including free play, when acted upon by a lateral load of 0.45 kN, in all possible positions of adjustment.
  - .2 Positive restraint at position of maximum adjustment.
  - .3 Free play of multi-component ties maximum 1.2 mm when assembled in all possible configurations.
  - .4 Anchors shall allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall.

- .5 All ties for masonry veneer shall be designed and supplied by the masonry contractor in accordance with CSA S304.1.
  - .1 All ties to steel studs are to be side-mount type; face-mount not acceptable.
- .3 Face-Mount Tie Assemblies (poured concrete or concrete unit masonry):
  - .1 Backer Plate: fabricated from 16-gauge carbon steel meeting requirements of CSA A370 and ASTM A1011 CS Type B; hot dip galvanized after fabrication and designed to transfer loads to structure; length as required to suit total cavity, insulation and sheathing thickness, hot dip galvanized in accordance with ASTM A123.
  - .2 V-Ties: 4.7625 mm diameter solid carbon steel wire, to ASTM A1064, hot dip galvanized after fabrication, fabricated from carbon steel wire in accordance with CSA G30.18; length to allow for cavity width and to extend minimum 50 mm into masonry unit joint, hot dip galvanized in accordance with ASTM A153.
  - .3 Fasteners: screws designed for type of backup substrate, poured concrete or concrete unit masonry, hot dip galvanized after manufacture. For concrete and concrete unit masonry backup walling, fasteners shall consist of close-tolerance bits for use in percussion drills, and hammer-driven anchors with pullout strengths of 5.4 kN for 20 MPa concrete and 3.75 kN for hollow concrete masonry unit with a minimum 25 mm embedment.
  - .4 Insulation Support: purpose-made from polyethylene to hold the insulation tightly against the air and vapour barrier membrane.
  - .5 Mechanical free-play: 0.80 mm.
  - .6 Factored resistance: 1.51 kN.
  - .7 Spacing: as per reviewed engineered Shop Drawings.
  - .8 Acceptable Materials:
    - .1 FERRO Thermal Tie™ - Heavy-Duty Holed Rap-Tie® Masonry Connector System, by Fero® Corporation, or approved equivalent.
- .4 Side-of-Stud Mount Tie Assemblies (structural metal stud framing):
  - .1 Tie Support: Fabricated from 16-gauge carbon steel meeting requirements of CSA A370 and ASTM A1011/A1011M; hot dip galvanized after fabrication in accordance with ASTM A123/A123M; designed to transfer loads to steel stud framing; length to suit total cavity, insulation and sheathing thickness.
  - .2 Ties: Wire ties fabricated from carbon steel wire in accordance with CSA G30.18; length to allow for cavity width and to extend minimum 50 mm into masonry unit joint; hot dip galvanized after fabrication in accordance with ASTM A153/A153M.
  - .3 Fasteners: self-tapping metal screws to metal stud backup as recommended by tie manufacturer; of sufficient length to penetrate minimum 13 mm into steel stud.
  - .4 Insulation Support: Purpose-made from polyethylene to hold the insulation tightly against the air and vapour barrier membrane.
  - .5 Mechanical free-play: 0.50 mm.
  - .6 Factored resistance: 2.5 kN.
  - .7 Spacing: as per reviewed engineered Shop Drawings.
  - .8 Acceptable Materials:
    - .1 FERRO Thermal Tie™ – Slotted Stud (Type II) Masonry Connector, by Fero® Corporation, or approved equivalent.

- .5 Lateral Tie Clips:
  - .1 Masonry veneer requires single-wire reinforcement to run through to the masonry ties at each course with ties. Supply 3/16" (4.76 mm) diameter continuous carbon steel wire, to ASTM A82, during installation of ties, hot dipped galvanized, lengths as required.
  - .2 Connect continuous wire to each masonry tie using a proprietary 16-gauge carbon steel lateral tie clip, hot dipped galvanized, such as Fero® Lateral Tie Clip, or approved equivalent.
  - .3 All steel materials to be hot dip galvanized after fabrication, minimum 460 g/m<sup>2</sup>/side.
  - .4 Locations: as per reviewed engineered Shop Drawings.
- .6 Z-Bar Connectors:
  - .1 Fabricated from 4.76 mm carbon steel plate, hot dip galvanized after fabrication, 50 mm wide, lengths as required to suit conditions and engineered Shop Drawing requirements, with 50 mm legs. The purpose of the Z-bar connectors is to connect masonry walls to masonry walls and to other structural members. These bars provide lateral support to the top of masonry walls as well as resist wind and forces acting normal to the wall.
    - .1 Fero® Z-Bar system, or approved equivalent.
  - .2 Locations: as per reviewed engineered Shop Drawings
- .7 Lateral Partition Supports (Top of Wall Anchors):
  - .1 Locations: as per reviewed engineered Shop Drawings.
  - .2 Angle Support: Fabricated from 2.657 mm core metal thickness angled steel plate having 75 mm long legs fastened to deck structure to allow vertical movement of masonry assembly; hot dip galvanized; coordinate with Section 07 84 00 - Firestopping and Smoke seals for firestopping insulation and smoke seals.
    - .1 PTA 422, Blok Lok, or approved equivalent.
  - .3 Plate Support: Fabricated from 2.657 mm core metal thickness [stainless] steel plate with 10 mm diameter metal 150 mm long welded to plate having closed end plastic tube fitted over rod that allows rod to move in and out of tube; [hot dip galvanized after fabrication].
    - .1 PTA 420, Blok Lok, or approved equivalent.
  - .4 Rigid T-Intersection Anchors: Fabricate from steel bars 38 mm wide x 6 mm thick x 600 mm long with ends turned up 50 mm or with cross pins at installers option; carbon steel hot dip galvanized after fabrication.
- .8 Anchor Bolts: headed or L-shaped steel bolts in accordance with ASTM A307, Grade A; with ASTM A563/A563M hex nuts and, where indicated, flat washers; carbon steel hot dip galvanized after fabrication.
- .9 Post-Installed Anchors: Provide torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete when tested in accordance with ASTM E488 conducted by a qualified independent testing agency, and as follows:
  - .1 Indoor Locations: Carbon-steel components zinc-plated in accordance with ASTM B633, Class Fe/Zn 5.
  - .2 Outdoor and High Humidity Locations: carbon steel bolts hot dip galvanized after fabrication steel complying with ASTM F593/F738M and nuts complying with ASTM F594/ASTM F836M.



- .3 Fastening into Solid Concrete or Solidly Grouted Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts into new or existing concrete or grout, and as follows:
  - .1 Epoxy Composition: Sealed packaging containing resin, hardener, cement and water; components.
  - .2 Curing Time: Rapid set, high strength and stiffness; maximum time 45 minutes at 20°C.
  - .3 Acceptable Material: Hilti Inc., HIT HY150 System.
- .4 Fastening to Hollow Wall Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts, with cylindrical mesh screen tube into new or existing masonry cavity wall, and as follows:
  - .1 Epoxy Composition: Sealed packaging containing resin, hardener, cement and water.
  - .2 Curing Time: Rapid set, high strength and stiffness; maximum time 60 minutes at 20 C.
  - .3 Acceptable Materials: Hilti Inc., HIT HY20 System.
- .10 Toggle Bolts: Tumble wing type, class, and style as required for supported construction.

## 2.11 FLASHING

- .1 Sheet metal flashing: to Section 07 62 00.
- .2 Butyl rubber flexible base flashing: minimum 1.2 mm thick butyl sheet rubber strips.
- .3 Sheet steel base flashing: minimum 0.60 mm thick, to ASTM A653, formed as detailed, galvanized with Z275 zinc coating.
- .4 Modified Bitumen Base Flashing: SBS modified sheet membrane, minimum 1.0 mm thick self-adhering type or minimum 3.0 mm thick torch-applied type.
- .5 Through-Wall and Flexible Flashings: Install flexible membranes where required to maintain flow direction to divert water away from face of building envelope.
  - .1 Acceptable Materials:
    - .1 Bakor Blueskin TWF, Henry Company.
    - .2 Mighty Flash, Hohmann & Banard Inc.

## 2.12 ACCESSORIES

- .1 Preformed gaskets at concrete block control joints:
  - .1 Acceptable Materials:
    - .1 RS Series Rubber Control Joint, by Hohmann & Barnard, Inc.
- .2 Steel Lintels: refer to Section 05 50 00 – Metal Fabrications.
- .3 Slot Seal Standard 2015-3, by Williams Products
- .4 Wall-mounted stainless steel and hard rubber door bumpers: TZ 5014, L 120 mm, by Dorma, or approved similar. Install as indicated.
- .5 Firestopping: to Section 07 84 00.
- .6 Sealants: to Section 07 92 00.
- .7 Deflection Space Fillers at Non-Rated Assemblies: Roxul AFB or AD Fire Barrier Insulation.

- .8 Slip Sheet for Lintel Bearing Locations: 20 mil thick PVC membrane, F20 by Lexsuco.
- .9 Joint Filler: Control Joint Fillers: preformed rubber, neoprene or polyvinylchloride, size and profile to suit intended application.
- .10 Bond Breaker Strips: #15 asphalt saturated, organic roofing felt in accordance with CSA A123.3.
- .11 Cavity Drainage Material: Pre-manufactured cavity insert, sized for width of cavity designed to offset or stagger the accumulation of mortar droppings to reduce risk of clogging vents or weeps:
  - .1 Acceptable Materials:
    - .1 Mortar Net USA, Mortar Net.
    - .2 Blok-Lok, Mor-Control.
- .12 Air Circulation and Weep Vents (insect and rodent proof):
  - .1 Acceptable Materials:
    - .1 CavClear® Weep Vents, by Archovations, Inc..
    - .2 TERM Weep and Vent Barrier, by Polyguard Products, Inc.
    - .3 QV - Quadro-Vent, by Hohmann & Barnard, Inc.
    - .4 CellVent, by Mortar Net Solutions.
    - .5 CellVent, by Blok-Lok.
- .13 Cavity Wall Insulation: as noted on Drawings.
- .14 Flashing and trim: to Section 07 62 00.
- .15 Air and Vapour Barrier Membrane: to Section 07 27 14. Coordinate products to ensure continuity of air and vapour barrier performance and compatibility of materials.
- .16 Other accessories and materials as required for a complete installation in accordance with Part 3 of this specification Section.

## **2.13 FINISHES**

- .1 Hot dip galvanizing:
  - .1 Coating TO BE applied after fabrication to all surfaces.
  - .2 Sheet: to ASTM A653/A653M.
  - .3 Hardware: to ASTM A153/A153M.
  - .4 Other steel products: to ASTM A1223/A123MM.

## **2.14 CLEANING COMPOUNDS**

- .1 Use low VOC products in compliance with SCAQMD Rule 1168.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.

## **Part 3 Execution**

### **3.1 REQUIRED COMPLIANCE**

- .1 Compliance – General (applies to the Work of this Section):
  - .1 Comply with the manufacturer's published installation instructions, data sheets, specifications and standard details.
  - .2 Meet the requirements as noted on the structural design Drawings.

- .3 Meet the requirements as noted on the design Drawings prepared by all relevant professional, provincially licensed disciplines.
- .4 Meet the requirements of the Ontario Building Code.

### **3.2 EXAMINATION**

- .1 Verify surfaces and conditions are ready to accept work of this Section.
- .2 Examine work of other Sections upon which work of this section is dependent. Should discrepancies be found which affect the proper performance of the work of this section, do not commence work until such discrepancies have been resolved.

### **3.3 PREPARATION**

- .1 Protect adjacent finished materials from damage due to masonry work.

### **3.4 INSTALLATION – GENERAL**

- .1 Work shall conform to CAN/CSA A371 and reviewed engineered Shop Drawings.
- .2 At interior locations where gypsum board is scheduled as indicated on Drawings, coordinate as required and build-in components as required to facilitate gypsum board and metal framing installations.
- .3 Where mortar has started to harden at units requiring repositioning, remove and replace with fresh mortar.
- .4 Masonry horizontal and vertical joints to be 10 mm thick except where adjustments are necessary to maintain the bond pattern or to adjust coursing.
- .5 Install dampproof course or through-wall flexible flashing material at top of foundation walls, and where shown on Drawings. Lap 100 mm at joints, seal lap with adhesive.

### **3.5 CONCRETE BRICK**

- .1 Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement type joints, returns, and offsets; avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- .2 Construct cavity walls using techniques that will minimize mortar dropping in cavity space. This may require the use of batten boards to catch mortar droppings. No mortar shall bridge cavity space or plug cavity vents at bottom of cavity.
- .3 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.
- .4 Install hollow masonry units using face shell bedding with full head and bed joints. Minimize mortar protruding or dropping into core spaces.
- .5 Bond: stacked bond.
- .6 Coursing height: as indicated on Drawings.
- .7 Jointing: concave.
- .8 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.
- .9 Clean concrete brick and unit masonry as work progresses.
- .10 Tolerances: to CAN/CSA A371.

### **3.6 CONCRETE UNIT MASONRY**

- .1 Standard and fire-rated concrete block units:
  - .1 Bond: running, or as otherwise indicated.
  - .2 Coursing height: 200 mm for one block and one joint.
  - .3 Jointing: flush where exposed or where paint or other finish coating is specified.
- .2 Special Shapes:
  - .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module. Use bullnose units to form interior wall corners.
  - .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
  - .3 End bearing: not less than 200 mm, or as otherwise indicated on drawings.
  - .4 Install special site cut shaped units.
- .3 Cull out masonry units, in accordance with CSA A165 and reviewed range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.
- .4 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves, and conduits.
- .5 Construct masonry walls using running bond unless otherwise noted.
- .6 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .7 Fit masonry closely against electrical and plumbing outlets so collars, plates, and covers overlap and conceal cuts.
- .8 Install movement joints and keep free of mortar where indicated.
- .9 Hollow Units: spread mortar bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .10 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .11 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .12 Tamp units firmly into place.
- .13 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean, and reset units in new mortar.
- .14 After mortar has achieved initial set up, tool joints.
- .15 Do not interrupt bond below or above openings.

### **3.7 TOLERANCES**

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CSA A165.1, supplemented as follows:
  - .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.
  - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
  - .3 Out of square tolerance not to exceed 2 mm.

- .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

### **3.8 CONNECTORS AND REINFORCEMENT**

- .1 Install masonry connectors and reinforcement in accordance with CSA A370, CSA A371, CSA A23.1, CSA S304.1 and reviewed engineered Shop Drawings.
- .2 Prior to placing mortar and grout, obtain Consultant's approval of placement of reinforcement and connectors.
- .3 Supply and install additional reinforcement to masonry as indicated and as required for seismic loads in accordance with Ontario Building Code requirements and reviewed engineered Shop Drawings.
- .4 If custom metal fabrication is required, refer to Section 05 50 00 - Metal Fabrications.

### **3.9 BONDING AND TYING**

- .1 Bond walls of two or more wythes using metal connectors in accordance with CSA S304.1, CSA A371 and reviewed engineered Shop Drawings.
- .2 Tie masonry veneer to structure in accordance with OBC, CSA S304.1, CSA A371 and as per reviewed engineered Shop Drawings.
- .3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CSA A370, CSA A371, manufacturer's instructions, and reviewed engineered Shop Drawings.
  - .1 Bond walls of two or more wythes using metal connectors in accordance with CSA A371 and as indicated.
  - .2 Install horizontal joint reinforcement 400 mm on centre.
  - .3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
  - .4 Place joint reinforcement continuous in first and second joint below top of walls.
  - .5 Lap joint reinforcement ends minimum 200 mm.
  - .6 Connect stack bonded unit joint corners and intersections with anchors 400 mm on centre.

### **3.10 REINFORCED LINTELS AND BOND BEAMS**

- .1 Reinforce masonry beams, masonry lintels and bond beams as per reviewed engineered Shop Drawings.
- .2 Place and grout reinforcement in accordance with CSA S304.1, CSA A371, CAN/CSA A179, and reviewed engineered Shop Drawings.
- .3 Support and position reinforcing bars in accordance with CSA A371 and reviewed engineered Shop Drawings.

### **3.11 GROUTING**

- .1 Grout masonry in accordance with CSA S304.1, CSA A371 and CAN/CSA A179 and reviewed engineered Shop Drawings.

### **3.12 ANCHORS**

- .1 Install metal anchors in accordance with CSA A370 and CSA A371 and reviewed engineered Shop Drawings.

**3.13 LATERAL SUPPORT AND ANCHORAGE**

- .1 Install lateral support and anchorage in accordance with CSA S304.1 and reviewed engineered Shop Drawings.

**3.14 CONTROL AND EXPANSION JOINTS**

- .1 Install control and expansion joint materials as per CAN/CSA A371, CSA S304 and reviewed engineered Shop Drawings.
- .2 Install control and expansion joint materials in unit masonry as masonry progresses; do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- .3 Form control joints in concrete masonry consisting of a complete vertical break free from mortar using one of the following methods:
  - .1 Break joint reinforcement at control joints, but extend bond beam reinforcing 400 mm into wall across control joint and wrap with 0.15 mm polyethylene bond breaker.
  - .2 Fit bond breaker strips into hollow contour in ends of concrete masonry units on one side of control joint; fill resultant core with grout and rake out joints in exposed faces for application of sealant.
  - .3 Install preformed control joint gaskets designed to fit standard sash block.
  - .4 Install interlocking units designed for control joints; install bond breaker strips at joint; keep head joints free and clear of mortar or rake out joint for application of sealant.
  - .5 Install temporary foam plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
  - .6 Refer to Drawings for control and expansion joint locations, and vertical reinforcing requirements; confirm location with Consultant before installation; confirm with Consultant where not shown on Drawings.
- .4 Install a minimum 10 mm high horizontal, pressure relieving joints by inserting a compressible filler, sealant and backer rod specified in Section 07 92 00; locate horizontal, pressure relieving joints beneath shelf angles supporting masonry.
- .5 Locate joints at 6000 mm centres maximum and at a maximum of 4000 mm from any corners, any other indication notwithstanding.

**3.15 FIELD BENDING**

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars and connectors that develop cracks or splits.

**3.16 FLASHING**

- .1 Build in flashing in masonry in accordance with CSA A371.
  - .1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity is interrupted by horizontal members or supports and as shown on drawings. Install flashings under weep hole courses and as indicated.

- .2 In cavity walls and veneered walls, carry flashings from front edge of exterior masonry, under outer wythe, then up backing not less than 150 mm, and as follows:
  - .1 For masonry backing embed or bond flashing 25 mm in joint.
  - .2 For concrete backing, insert or bond flashing into reglets.
  - .3 For wood frame backing, staple flashing to walls behind water resistive paper, and lap joints.
  - .4 For gypsum board and glass fibre faced sheathing backing, bond to wall using manufacturer's recommended adhesive.
- .3 Lap joints 150 mm and seal with adhesive.
- .2 Form flashing (end dams) at lintels, sills and wall ends to prevent water from travelling horizontally past flashing ends.
- .3 Install vertical flashing where outer veneer returns at window or doorjamb, to prevent contact of veneer with inner wall.

### **3.17 CELL VENTS FOR DRAINAGE AND AIR CIRCULATION**

- .1 Install weep vents in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  - .1 Use pre-manufactured inserts to form weep vents, spaced as follows:
    - .1 Space open head joint weep holes at a maximum of 600 mm o/c.
    - .2 Space weep vents formed from pre-manufactured inserts at a maximum of 400 mm o/c.
- .2 Install vents in head joints in exterior wythes at same spacing as indicated for weep vents at top of wall and immediately below any cavity obstruction; use same methods to form vents as weep vents listed above.
- .3 Do not use manufactured vent forms.

### **3.18 ACCESSORIES**

- .1 Install firestopping to Section 07 84 00, as required to achieve required ratings.
- .2 Install spray-foam insulation: to Section 07 21 19.19, at gaps and penetrations to ensure continuity of air seal.
- .3 Install sealants: to Section 07 92 00, at joints and penetrations to ensure continuity of weatherproofing and soundproofing.
- .4 Install cavity drainage material to maintain cavity free of obstructions in order to accommodate free drainage through weep holes.
- .5 Install cavity wall insulation: to Section 07 21 13, as required to achieve required insulation values and continuity of thermal insulation.
- .6 Install air and vapour barrier membrane: to Section 07 27 14, as required to ensure continuity of air and vapour barrier performance.
  - .1 Coordinate products to ensure continuity of air and vapour barrier performance and compatibility of materials.
- .7 Install other accessories as required for a complete installation of wall assemblies.

### **3.19 REPAIR/RESTORATION**

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

### **3.20 FIELD QUALITY CONTROL**

- .1 Field quality control inspections and testing: in accordance with the requirements of Section 01 29 83 – Testing and Inspection Services and Section 01 45 00 - Quality Control.
- .2 Allow access to scaffold and worksite as required to perform inspections and tests.
- .3 Have a qualified independent testing and inspecting agency perform field tests and inspections and prepare test reports as follows:
  - .1 Testing Frequency: One set of tests for each 450 m<sup>2</sup> (5000 ft<sup>2</sup>) of wall area or portion remaining.
  - .2 Concrete masonry units will be sampled and tested by independent testing agency in accordance with CSA S304.1.
  - .3 Masonry Unit Test: For each type of unit provided, in accordance with CSA A82.2 and ASTM C67.
  - .4 Mortar and Test (Proportion Specification): For each mix provided, in accordance with CSA A179 for mortar air content and compressive strength.
  - .5 Prism Test: For each type of construction provided, in accordance with CSA A179 at 7 days and at 28 days.
  - .6 Concrete Cylinder Tests at 7 days and at 28 days.

### **3.21 MASONRY CLEANING**

- .1 Concrete Brick Masonry:
  - .1 Perform cleaning within 24 hours after masonry walling has had a chance to fully dry out after erection to remove efflorescence (i.e., “new building bloom”), and construction and accumulated environmental dirt.
  - .2 Clean concrete masonry: 10 m<sup>2</sup> area of wall designated by Consultant and leave for one week. If no harmful effects appear and after mortar has set and cured, protect windows, sills, doors, trim and other work, and clean masonry as follows:
    - .1 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
    - .2 Scrub with solution of 25 mL trisodium phosphate and 25 mL household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by masonry manufacturer in accordance with manufacturer's directions.
    - .3 Repeat cleaning process as often as necessary to remove mortar and other stains.
- .2 Concrete Unit Masonry:
  - .1 Progress Cleaning:
    - .1 Standard and Fire-Rated Concrete Unit Masonry:
      - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
  - .3 Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

### **3.22 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.



- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.23 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.24 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 04 22 00 - Unit Masonry.
- .2    Section 05 50 00 - Metal Fabrications.
- .3    Section 08 11 14 - Metal Doors and Frames.
- .4    Section 08 44 13 - Glazed Aluminum Framing Systems.
- .5    Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2            SUMMARY**

- .1    Design wall framing system to resist post disaster wind loads to OBC and building loads, including the following components:
  - .1    Studs subjected to lateral loads.
  - .2    Top and bottom tracks.
  - .3    Bridging and bracing.
  - .4    Top and bottom track connections to main structure, including fabrications to accommodate main structure deflections; top of wall anchor allowing for dead load deflections during construction and live load deflections after construction.
  - .5    Head, sill, and jamb members at wall openings.
  - .6    Framing component connections.

**1.3            REFERENCES**

- .1    ASTM International (ASTM)
  - .1    ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2    ASTM A792/A792M-23, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .3    ASTM F3125/F3125M-23, 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.
- .2    CSA Group (CSA)
  - .1    CSA G164-18 (R2023), Hot Dip Galvanizing of Irregularly Shaped Articles, Includes Update No. 1 (2020).
  - .2    CSA S136-16 \*R2021), North American specification for the design of cold-formed steel structural members.
  - .3    CSA W47.1:19 (R2024), Certification of companies for fusion welding of steel.
  - .4    CSA W55.3-08 (R2023), Certification of companies for resistance welding of steel and aluminum.
  - .5    CSA W59:24, Welded Steel Construction.
- .3    Canadian Sheet Steel Building Institute (CSSBI)
  - .1    CSSBI 51-06, Lightweight Steel Framing Design Manual – 2<sup>nd</sup> Edition and Errata.
  - .2    CSSBI SSF 03-17, Care and Maintenance of Prefinished Sheet Steel Building Products.

- .3 CSSBI Technical Bulletin Vol. 7, No. 2, Standard Thickness for Canadian Lightweight Steel Framing Applications.
- .4 CSSBI S5-19, Guide Specification for Wind Bearing Steel Studs.
- .4 The Master Painters Institute (MPI) / Architectural Painting Specification Manual
- .1 MPI # 18, Organic Zinc Rich Primer.

#### 1.4 DEFINITIONS

- .1 CFS: means 'cold-formed steel framing', which is the same as 'structural metal stud framing', just different ways of saying the same thing.
- .2 Minimum Uncoated Steel Thickness: Minimum uncoated thickness of lightweight steel framing shall be not less than 95% of the thickness used in the design for the framing system:
  - .1 Lesser thicknesses may be permitted at bends arising from the cold forming process.
  - .2 Metal thicknesses listed in this section are minimum uncoated steel thickness; exclusive of any subsequent coatings or treatments.
- .3 Structural Metal Stud Framing: means the same as wind load bearing steel stud framing.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section with work of other sections that may have items supported by or built into axially load bearing lightweight structural steel framing systems including; but not limited to, masonry and stone supports and connectors, doors, windows, architectural woodwork, pre-manufactured casework, building signage, plumbing fixtures, and electrical fixtures and panels.

#### 1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals shall meet the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Submit product data:
  - .1 Submit manufacturer's published product literature, specifications and datasheets for all products and materials incorporated into the Work of Contract.
- .3 Submit engineered shop drawings:
  - .1 Shop Drawings shall bear the seal and signature of a delegated design structural professional engineer (P.Eng.) licensed to practice in the Province of Ontario.
  - .2 Indicate member sizes, framing layout, design thickness exclusive of coatings, coating specifications, connection and bracing details, screw sizes, stud spacings, fasteners and anchors.
  - .3 Show all connection, bracing and bridging details.
  - .4 Indicate welds using CWB symbols, distinguishing between shop and field welds and show size, length, and type of each weld.
  - .5 Show both design and installation requirements. Delegated design engineer (P.Eng.) shall prepare the design and shop drawings and perform site reviews as necessary. Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .4 Provide setting diagrams, templates, instructions, and directions for installation of components supplied by this Section to other Subcontractors and necessary for the completion of Work of this Section.

- .5 Certification:
  - .1 Submit two certified copies of mill reports covering material properties.
  - .2 Provide letter of certification by the Canadian Welding Bureau (CWB) that firms are currently in good standing.
  - .3 Submit confirmation by the Contractor's structural engineer that fabrication and erection comply with the requirements of the Contract Documents.

## **1.7 QUALITY ASSURANCE**

- .1 Retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Codes and Contract Document requirements, including the following:
  - .1 Design metal fabrication items as required to resist dead, live, lateral, wind, and seismic loads in accordance with the post-disaster requirements of OBC.
  - .2 Structural design.
  - .3 Review, seal and sign Shop Drawings.
  - .4 Conduct shop and on-site inspections as required.
  - .5 Prepare and submit inspection reports.
- .2 Provide certification that welding procedures will be in accordance with CSA W47.1.
- .3 Execute welding by firms certified in accordance with CSA W47.1.
- .4 Ensure welding operators are licensed in accordance with CSA W47.1 for the types of welding required by the Work.
- .5 Clearly mark steel thickness exclusive of coating by embossing, stamping with indelible ink or by colour coding.
- .6 Provide minimum 72 hours' notice to Consultant prior to commencement of work of this Section; increase notice period where time spans weekends or statutory holidays.
  - .1 Do not conceal lightweight steel framing system until reviewed by Consultant.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Protect steel studs during transportation, site storage, and installation in accordance with CSSBI Sheet Steel Facts #03.
- .2 Steel framing and related accessories shall be stored and handled in accordance with CSA S136.
- .3 Handle and protect galvanized materials from damage to zinc coating.
- .4 Store materials flat, blocked off the ground in a manner to prevent kinking or permanent set.
- .5 Bent, kinked, or twisted studs and track will be rejected.

## **Part 2 Products**

### **2.1 PERFORMANCE/DESIGN CRITERIA**

- .1 Perform design, fabrication, and erection of the work of this Section based on Limit States Design principles using factored loads and resistances, determined in accordance with CSA S136 and OBC.
- .2 Conform to the requirements of indicated fire resistance ratings.

- .3 Design wall framing system to post-disaster requirements of OBC, and capable of withstanding design loads within limits and under design loads indicated on Drawings, and as follows:
  - .1 Dead Loads: Weights of materials and construction.
  - .2 Live Loads: determine live loads in accordance OBC requirements unless noted otherwise on structural design Drawings.
  - .3 Lateral Loads: design for wind loads using post-disaster importance factors listed in OBC for deflection and strength, modified by the appropriate exposure, gust and pressure (internal and external) factors in accordance with Building Code structural commentaries.
  - .4 Design framing systems to provide for movement of framing members without damage or overstressing, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 70°C.
  - .5 Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure upward and downward movement of 25 mm; or larger gap as may be required to accommodate structural movement.
  - .6 Design deflection detail so that free floating vertical members are restrained from horizontal movement by means of continuous bridging, nested or boxed tracks, or sliding or flexible web connections.
  - .7 Concrete Brick Veneer: maximum allowable deflection under 1-in-50-year sustained wind loading shall be as follows: stud deflection limited to  $L/720$ .
  - .8 Allow for movement of the structure; design lightweight steel framing end connections to accommodate floor and roof deflections such that framing is not loaded axially; limit free play and movement in connections perpendicular to the plane of framing to  $\pm 0.50$  mm relative to the building structure.
  - .9 Design connections between light steel framing members using bolts, welding or sheet metal screws.
  - .10 Design bridging to prevent member rotation and member translation perpendicular to the minor axis, and as follows:
    - .1 Design for secondary stress effects due to torsion between lines of bridging.
    - .2 Design exterior wall framing to accommodate horizontal deflection.
    - .3 Design bridging at 1530 mm centres maximum, closer spacing may be required by design to satisfy structural requirements; spaced at even intervals over the span of the member.
  - .11 Stud, sill and top track sizes and thicknesses, and fastening details indicated in this Section and on the Drawings shall be considered as minimums only, spacing indicated as maximum permissible, except where changes are required to meet design criteria, and as follows:
    - .1 Design head, sill and jamb members to frame openings larger than 100 mm in any dimension.
    - .2 Design components or assemblies to accommodate specified tolerances of the structure.
    - .3 Sill and Top Tracks:
      - .1 Double track system, outer track flanges with depth to suit vertical deflection and width of studs.
      - .2 Sill tracks, minimum 33 mm deep flanges and width of studs.

- .4 Movement Connection Clips: Purpose-made clips designed to allow structural member vertical movement and to transfer wind suction or pressure to structural frame.
- .5 Maximum design spacing of stud members: as per engineered, sealed and signed shop drawings; confirm stud spacing with Consultant prior to application.
- .6 Maximum spacing for top and bottom track connections to the structure shall not exceed 812 mm centres.
- .7 Minimum design thicknesses for wall framing members shall be as follows:
  - .1 64 mm: 0.836 mm
  - .2 92 mm: 0.836 mm
  - .3 101 mm: 0.836 mm
  - .4 140 mm: 0.836 mm
  - .5 152 mm: 0.836 mm
  - .6 184 mm: 0.91 mm
  - .7 203 mm: 1.12 mm
  - .8 Minimum thickness for walls supporting masonry veneer shall be 1.22 mm regardless of minimum thickness indicated above, or thicker as required to suit design conditions.
- .8 Bridging Channel: 1.22 mm minimum.
- .9 Clip Angles: 1.52 mm minimum, or as otherwise specified
- .12 Clearly mark steel thickness exclusive of coating by embossing, stamping with indelible ink or by colour coding.

## 2.2 MATERIALS

- .1 Steel: to CSA S136, fabricated from ASTM A653M, Grade A to D steel.
  - .1 Steel studs 18 gauge and lighter shall have a minimum yield strength of 230 MPa; steel studs heavier than 18 gauge shall have a minimum yield strength of 350 MPa.
  - .2 Steel shall be hot dip galvanized after fabrication to minimum Z275, to ASTM A653M.
- .2 Zinc coated steel sheet: quality to ASTM A653M, with Z275 designation coating.
- .3 Thicknesses of framing members specified are exclusive of galvanized coating.
- .4 Fasteners and Welding Material; finish – hot dip galvanized after fabrication:
  - .1 Welding materials conforming to CSA W59; electrodes minimum 480 MPa tensile strength.
  - .2 Bolts and nuts conforming to ASTM F3125M as required, with washers; hot-dip galvanized finish.
  - .3 Metal-to-Metal: Sheet metal screws conforming to ASME 18, with minimum 0.008 mm thick galvanized coating and #8 Ø; self-drilling, self-threading, case hardened type; hex, pan, and low-profile head profile type to suit application; length sufficient to penetrate not less than 3 fully exposed threads beyond joined materials; hot dip galvanized.
  - .4 Metal-to-Concrete: Hilti drilled insert, minimum 8 mm Ø; do not use Powder Actuated Fasteners; hot dip galvanized.

- .5 Metal-to-Structural Steel: Secure track to structural steel over 8 mm thickness with Hilti DX fastening system with X-U nail or X-S nail.
- .6 Concrete-to-Steel Top Track Corrugated Ties: Corrugated steel conventional strip tie; 22 mm wide x 100 mm total length including 20 mm up stand x minimum 0.76 mm nominal core metal thickness, hot dip galvanized; corrugations 2.5 mm deep x 10 mm apart; meeting requirements of CAN/CSA A370:
  - .1 Basis-of-Design Material: Fero Corporation, Conventional Corrugated Strip Tie; hot dip galvanized.
- .7 Drilled Inserts: Steel, hot dipped galvanized, sizes as required.
- .8 IDCB Drift-Clip Bypass Framing Connectors, by Simpson Strong-Tie Company, including drift-clip bypass framing connectors and manufacturer's supplied fasteners as required for a complete installation. The connector system shall be designed and manufactured to accommodate 25 mm of lateral drift in each direction and 25 mm of upward and downward vertical deflection.
  - .1 Connector material: 97 mil (2.46 mm), 50 ksi (344.74 megapascal); hot dipped galvanized to minimum 275 grams per square meter (g/m<sup>2</sup>).
  - .2 Locations: only if required by the reviewed engineered Shop Drawings.
  - .3 Provide fasteners as required, and as follows:
    - .1 Simpson Strong-Tie XLSH78B1414 #14 Shouldered Screw for Attachment to Stud Framing.
    - .2 Simpson Strong-Tie Strong-Drive XL Large-Head Metal screws (XLQ114B1224) Screws for Anchorage to Steel Edge Angles.
- .5 Touch-up primer: touch-up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .6 Sill gasket materials: self-adhesive flexible closed cell polyethylene foam gasketing material, minimum 10 mm thick x 140 mm wide x 2030 mm long, bonded to a layer of 20-mil peel and stick rubberized asphalt.
  - .1 Top of Foundation: sill seal rubberized asphalt shall have 120 mm wide peel-and-stick T-shaped cross-section flange at 90-degree angle to the foam gasket, designed to seal outside face of concrete foundations and to the wall assembly above.
    - .1 Acceptable Materials:
      - .1 Triple Guard Energy Sill Sealer, by Protecto Wrap, or equivalent.
  - .2 Sill Gasketing at other interfaces (e.g., between all tracks, upper and lower, and concrete surfaces):
    - .1 Acceptable Materials:
      - .1 FoamSealR™ Gasket, by Owens Corning;
      - .2 Energy Plate Liner, by Protecto Wrap;
      - .3 or equivalent.
- .7 Shims: load-bearing, high-density, multi-monomer plastic, non-leaching.
- .8 Insulation: as indicated on Drawings.
- .9 Metal fabrications, to Section 05 50 00 - Metal Fabrications.
- .10 Air and vapour control materials: to Section 07 27 14.10 - Air and Vapour Control Layers.

## **2.3 STEEL STUD DESIGNATIONS**

- .1 Framing identification: Each structural "C" stud component shall be identified with a factory applied marking denoting the manufacturer's name and gauge thickness of the steel. Studs manufactured from 230 MPa (33 ksi) material or 350 MPa (50 ksi) steel shall be appropriately marked to designate their properties. The framing Subcontractor shall be responsible for notifying the manufacturer in writing of this requirement.
- .2 Colour code: to CSSBI Technical Bulletin Vol.7, No. 2.

## **2.4 METAL FRAMING**

- .1 Comply with OBC design criteria.
- .2 Minimum steel thicknesses of framing elements: to engineered Shop Drawings. All steel materials to be hot dipped galvanized to Z275, minimum.
  - .1 Steel studs: to CSA S136, fabricated from hot dip galvanized steel, depth as per engineered Shop Drawings.
  - .2 Stud tracks: fabricated from the same material and finish as steel studs, depth to suit.
  - .3 Bottom track: single piece.
  - .4 Top track: two-piece telescoping as indicated in the engineered Shop Drawings.
  - .5 Bridging: fabricated from the same material and finish as studs, 38 mm x 12 mm. Provide as required to meet OBC.
  - .6 Angle clips: fabricated from the same material and finish as studs, 38 mm x 38 mm x depth of steel stud.
  - .7 Tension straps and accessories: as recommended by the framing manufacturer to suit design and site conditions.
  - .8 Stud framing: depth, thickness, and spacings as per engineered Shop Drawings.

## **2.5 SOURCE QUALITY CONTROL**

- .1 Ensure mill reports covering material properties are reviewed by Consultant.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Fabrication and erection shall conform to the engineered Shop Drawings. Modifications required to accommodate as-built conditions (other than minor dimensional changes) shall be submitted to Consultant for review.
- .2 Do welding in accordance with CSA W59.
- .3 Certification of companies: CSA W47.1 for fusion welding and CSA W55.3 for resistance welding.
- .4 Do work to OBC, CSSBI 51 guidelines, and CSSBI S5.

### **3.2 FASTENERS AND WELDS**

- .1 Ensure that connected parts are in contact. Provide clamping before installing screws as required.
- .2 Sheet metal screws shall be not less than a #8 size and as recommended by the stud framing manufacturer.



- .3 Penetration of sheet metal screws beyond joined materials shall be more than three exposed threads.
- .4 Sheet metal screw thread types, drilling capability, and installation shall conform to the manufacturer's printed recommendations.
- .5 Install concrete expansion and adhesive anchors in accordance with the manufacturer's printed recommendations; use adhesive anchors at locations where edge distance requirements for expansion anchors cannot be met. Anchor framing to structure with concrete drilled anchors and sleeves, maximum spacing shall be 400 mm on centre, or as otherwise indicated on engineered Shop Drawings. Anchor bolt lengths shall not be less than 80 mm long and 12 mm in diameter. Ensure full embedment in concrete slab.
- .6 Companies engaged in welding shall be certified by the Canadian Welding Bureau in accordance with CSA W47.1. Companies shall have welding procedures approved, and welders qualified, for the base material types and thicknesses that are to be welded.
- .7 Welds shall be in accordance with CSA S136, CSA W48, CSA W59, as applicable.
- .8 For material less than 3 mm thick, the effective throats of welds shall not be less than the thickness of the thinnest connected part.
- .9 Touch-up welds and coatings damaged by welding with VOC-compliant, zinc-rich paint. Prior to touching up, prepare the surface in accordance with the paint manufacturer's printed recommendations.

### **3.3 DRIFT-CLIP BYPASS FRAMING CONNECTORS**

- .1 If required by the review Shop Drawings, provide as required.
  - .1 Use the manufacturer's specified type and number of fasteners and anchors.
  - .2 Install drift-clip connectors as indicated, and as required to meet OBC requirements; to be attached to steel bent plate and edge angles as indicated on Drawings.
  - .3 In the vertical slots, use the manufacturer's specified number of #14 shouldered screws (included) for attachment to the stud. Install screws to align with the No-Equal stamp.
  - .4 For attachment to a minimum 3/16"- and maximum 1/2"-thick steel edge angle, use Simpson Strong-Tie Strong-Drive XL Large-Head Metal screws (XLQ114B1224). Use one screw centered in each horizontal slot. Install screws to align with the No-Equal stamp and back out 1/2 turn.
  - .5 For fastener installation into steel backed by concrete, predrilling of both the steel and the concrete may be required. For predrilling, use a maximum 3/16"-diameter drill bit.

### **3.4 ERECTION**

- .1 Anchor tracks securely to structure at 800 mm on centre, maximum, unless lesser spacing is indicated on the engineered Shop Drawings.
- .2 Erect steel studs spaced at 400 mm on centre or at less as indicated on the engineered Shop Drawings.
- .3 Erect studs plumb, aligned, and securely attached with two screws, minimum.
- .4 Seat studs into bottom tracks and top track.
- .5 Install 50.0 mm minimum telescoping track at top of walls when required to accommodate vertical deflection. Nest top track into deflection channel a minimum of 30.0 mm and a maximum of 40.0 mm. Do not fasten tracks together. Stagger joints.

- .6 Install studs at not more than 50.0 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.
- .7 Brace steel studs with horizontal internal bridging at 1200 mm maximum, or as otherwise indicated on the Shop Drawings. Fasten bridging to steel clips fastened to steel studs with screws.
- .8 Frame openings in stud walls to carry loads adequately by use of additional framing members and bracing as required.
- .9 Provide cut-outs centred in the webs of members to accommodate services and through the knockout style of bridging.
- .10 Unless otherwise detailed, supply and install studs at each side of openings and triple double studs at wall corners. Continue regular stud spacing above and below openings.
- .11 Supply and install continuous bent galvanized metal angles at perimeter of door, curtainwall, window, and louvre openings where indicated, minimum 2 mm thick. Secure angle to wall studs with 2 rows of screws, staggered. Design to allow for connection loads from window, curtain wall, door, and louvre systems to walls.

### 3.5 ERECTION TOLERANCES

- .1 Plumb: not to exceed 1/500th of member length.
- .2 Camber: not to exceed 1/1000th of member length.
- .3 Spacing: not more than +/- 3.0 mm from design spacing.
- .4 Gap between end of stud and track web: not more than 4.0 mm.

### 3.6 CUT-OUTS

- .1 Maximum size of cut-outs for services as follows:
 

Member Depth	Across Member Depth	Along Member Length	Centre to Centre Spacing (mm)
90	40 max.	105 max.	600 min.
100	40 max.	105 max.	600 min.
150	65 max.	115 max.	600 min.
- .2 Limit distance from centerline of last unreinforced cut-out to end of member to not less than 300 mm.

### 3.7 FIELD QUALITY CONTROL

- .1 The Contractor's structural engineer shall provide periodic field review during construction and shall submit reports as specified. Field review shall include review of mill test reports, welded and screwed connections, connections to the main structure, member sizes, location and material thickness, coating thickness, erection tolerances, bolted connections, and field cutting.
  - .1 Shop testing shall be paid for by supplier, field verification/testing by Owner.
- .2 At the election of Owner, additional inspection and testing of materials and workmanship may be carried out by a qualified independent inspection agency appointed by the Owner.
  - .1 Provide the necessary cooperation and access required to ensure that inspections can proceed.

- .2 The inspection provided does not relieve the Contractor of its responsibility for the performance of the Contract. The Contractor is solely responsible for quality control and shall implement its own supervisory and quality control procedures.
- .3 The Contractor cannot rely on timely discovery and reporting of defective Work. Materials or workmanship not conforming to the requirements of the Contract may be rejected at any time during the progress of the Work at no cost to Owner, even if the Contractor has to destroy and rebuild other work as a result.

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.9 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.10 SCHEDULE**

- .1 Install as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section specifies requirements for metal fabrications and is to be read in conjunction with the Drawings and technical Specifications that require metal fabrications for complete installations.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A53/A53M-24, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .4 ASTM A240/A240M-25, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, and Strip for Pressure Vessels and for General Applications.
  - .5 ASTM A269/A269M-24, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .6 ASTM A276/A276M-24a, Standard Specification for Stainless Steel Bars and Shapes.
  - .7 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .8 ASTM A312/A312M-24b, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .9 ASTM A480/A480M-25, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .10 ASTM A666-24, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .11 ASTM A500/A500M-23, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - .12 ASTM A666/A666M-24, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .13 ASTM A747/A747M-23, Standard Specification for Steel Castings, Stainless, Precipitation Hardening.
  - .14 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .15 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .16 ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .17 ASTM B308/B308M-20, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
  - .18 ASTM B429/B429M-20, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
  - .19 ASTM B632/B632M-24, Standard Specification for Aluminum-Alloy Rolled Tread Plate.

- .20 ASTM D1187/D1187M-97(2024), Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
- .21 ASTM F468-23, Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.
- .22 ASTM F593-24, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- .23 ASTM F3125/F3125M-23, 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.
- .2 American Welding Society (AWS)
  - .1 AWS D1.6/D1.6M:2017, Structural Welding Code - Stainless Steel.
  - .2 AWS D18.1/D18.1M:2020, Specification for Welding of Austenitic Stainless Steel Tube and Pipe Systems in Sanitary (Hygienic) Applications.
- .3 CSA Group (CSA)
  - .1 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CSA S16:24, Design of steel structures, Includes Errata (2019).
  - .3 CSA W47.1:19, Certification of companies for fusion welding of steel.
  - .4 CSA W48:23, Filler metals and allied materials for metal arc welding.
  - .5 CSA W55.3-08 (R2023), Certification of companies for resistance welding of steel and aluminum.
  - .6 CSA W59:24, Welded Steel Construction, Includes Errata (2020).
  - .7 CSA W178.2:18, Certification of Welding Inspectors.
- .4 National Association of Architectural Metal Manufacturers (NAAMM)
  - .1 NAAMM AMP 555, Code of Standard Practice for the Architectural Metal Industry, most recent published edition.
- .5 National Ornamental & Miscellaneous Metals Association (NOMMA)
  - .1 NOMMA Guideline 1: Joint Finishes, most recent published edition.
- .6 SAE International (The Society of Automotive Engineers)
  - .1 SAE steel grades.
- .7 Specialty Steel Industry of North America (SSINA)
  - .1 SSINA Designer Handbook: Stainless Steel Fabrications.
- .8 Steel Structures Painting Council (SSPC), Systems and Specifications Manual, Volume 2.

### 1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- .1 Supply following products for installation under other Sections:
  - .1 Anchor bolts, bearing plates, sleeves and other inserts to be built into concrete and masonry elements and required for anchorage and support of fabricated steel components.
  - .2 Fabricated steel components to be built into concrete and masonry.
- .2 Supply instructions and templates as required for accurate setting of inserts and components.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit manufacturer's printed product literature, specifications and data sheets.
- .2 Submit Shop Drawings as follows:
  - .1 Indicate materials, core thicknesses, finishes, welds, connections and joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - .2 Submit Shop Drawings for fabricated stainless steel countertop with integral sinks for initial approval of design concept, and then, after approval, for confirmation of the design to be fabricated.
  - .3 For items where design is delegated to fabricator or otherwise require structural design (e.g., support structures and backing plates for toilet partitions, operable partitions, glass partitions and screens, toilet and bath accessories, wall-mounted casework, shelves, benches, desks, and counters, suspended mechanical items, suspended panels and ceilings, etc.), provide shop drawings signed and sealed by Professional Engineer responsible for the design and registered in Province of Work. Include engineering calculations with engineered shop drawings.
    - .1 Design for post-disaster importance factors listed in OBC for deflection and strength, and as per OBC commentaries as required. Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.

#### **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.
- .3 Detail and fabricate metal fabrications in accordance with the NAAMM AMP 555.
- .4 Perform Work to the highest standard of modern shop and field practice, by personnel experienced in this Work. Accurately fit joints and intersecting members in true planes with adequate fastening. Build and erect the Work plumb, true, square, straight, level, accurate to the sizes shown, and free from distortion or defects.
- .5 Fabricator Qualifications (carbon Steel): A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance for a minimum of 5-years, as well as sufficient production capacity to produce required units within the project construction schedule.
- .6 Fabricator Qualifications (stainless steel): A firm experienced in producing stainless steel fabrications similar to those indicated for this Contract and with a minimum 5-year record of successful in-service performance, as well as sufficient production capacity to produce required units.
- .7 Welding: Qualify procedures and personnel according to the following:
  - .1 Welders shall be qualified by Canadian Welding Bureau for classification of work being performed.
  - .2 The fabricator shall be certified to CSA W47.1, Division 1 or 2.1.
  - .3 Perform welding inspection to CSA W178.2.
  - .4 Resistance welding: to CSA W55.3.
  - .5 Fusion welding: to CSA W59.

- .8 Stainless Steel Welding:
  - .1 Welding of stainless steel shall be by the electric arc process.
  - .2 Weld stainless steel by the electric arc process, to CSA W59.
  - .3 Use electrodes compatible with and of the same properties as the stainless steel. Grind smooth and polish to match finish.
  - .4 Structural stainless steel welding: to AWS D1.6/D1.6M.
  - .5 Stainless steel tube and pipe: to AWS D18.1/D18.1M.
  - .6 Joint finish requirements: to NOMMA Guidelines 1: Joint Finishes: Finish #1 - Ornamental Quality, No Evidence of a Welded Joint.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Exercise due care in storing, handling and erecting all materials and support all materials properly at all times so that no piece will be bent, twisted or otherwise damage structurally or visibly.
- .2 Correct damaged material and where the Consultant deems damage irreparable, replace the affected items at no additional expense to the Consultant or Owner.
- .3 Apply protective covering to face of all exposed finished metalwork before it leaves shop, covering to remain until item installed.
- .4 Fabricate large assemblies so they can be safely and easily transported and handled to their place of installation.

## **1.7 JOB CONDITIONS**

- .1 Coordinate metal fabrications work with the remainder of the Work and exercise the necessary scheduling to ensure that all Work is carried out and all items incorporated during the appropriate construction phase.
- .2 Provide instructions and drawings to other trades for setting bearing plates, anchors bolts, and other members that are built in to work of other trades.
- .3 Protect other Sections of the Work from damage by this Section of the Work.

## **Part 2 Products**

### **2.1 PERFORMANCE AND DESIGN CRITERIA**

- .1 Provide delegated design as required.
- .2 Design Requirements:
  - .1 Design metal construction and connections in accordance with OBC and amendments for vertical and horizontal live load requirements.
- .3 Comply with CISC Code of Standard Practice for Structural Steel, Appendix I, Architecturally Exposed Structural Steel.
- .4 The ultimate support for all miscellaneous fabrications is the building's structural framing. The miscellaneous metals contractor is responsible for the design, fabrication and installation of all aspects of the required items including direct support methodology to the building's structural framing in the locations and configurations as described on the structural consultant documents.
  - .1 Design for post-disaster importance factors listed in OBC for deflection and strength, and as per OBC commentaries as required.

## 2.2 MATERIALS

### .1 Carbon Steel:

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W.
- .2 Structural steel: to CAN/CSA G40.20/G40.21, Grade 350W.
- .3 Hollow structural sections (HSS): to CSA G40.20/G40.21, Grade 350W, Class C.
- .4 Steel pipe: to ASTM A53/A53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads, galvanized finish.
- .5 Steel tubing: to ASTM A500/A500M, shapes and configuration as indicated, 6 mm wall thickness, sizes and dimensions as indicated.
- .6 Fasteners:
  - .1 Structural bolts: to ASTM F3125/F3125M.
  - .2 Bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws, and machine bolts, as required and as follows:
    - .1 Unfinished fasteners: In areas not exposed to public, use unfinished bolts conforming to ASTM A307, Grade A, with hexagon heads and nuts. Supply bolts of lengths required to suit the thickness of the material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.
    - .2 Finished fasteners:
      - .1 In areas exposed to public use, bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts to be hot dip galvanized in accordance with ASTM A153/A153M or CSA G164.

### .2 Stainless Steel:

- .1 Stainless steel sheet, to ASTM A480, Type 304 alloy stainless steel.
- .2 Stainless steel strip, sections, shapes, U-channels, plate and flat bar: to ASTM A240.
- .3 Stainless steel tubing: to ASTM A269.
- .4 Stainless steel piping: to ASTM A312/A312M; pipe to NPS Schedule 40S.
- .5 Stainless steel fittings and castings: to ASTM A747/A747M.
- .6 Structural stainless-steel fasteners: to ASTM A738/A738M.
- .7 Stainless steel fasteners, washers and nuts: to ASTM F593, type 316 austenitic stainless steel, sized as required for purpose intended, or as otherwise indicated. Cold Finished Materials: Condition B, cold worked, to ASTM A276. Exposed Fasteners: Stainless steel countersunk screws or bolts, consistent with design intent.
  - .1 Anchors shall be fabricated from stainless steel with capability to sustain, without failure, load imposed within a safety factor of 4, as determined by testing to ASTM E488.

### .3 Miscellaneous Materials:

- .1 Welding materials: to CSA W59.
- .2 Welding electrodes: to CSA W48 Series.
- .3 Grout: non-shrink, non-metallic, flowable.
- .4 Isolation and Separation Coating: bituminous paint or aerosol, to ASTM D1187; to separate dissimilar metals from each other and separate metals from other materials that may cause corrosion or deterioration of the metal.



## **2.3 FABRICATION**

- .1 Fabricate to applicable Building Code requirements.
- .2 Stainless steel fabrications: to SSINA Designer Handbook: Stainless Steel Fabrications, and as specified herein.
- .3 Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- .4 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .5 Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss. Temperature change (Range): 100 degrees Fahrenheit (38 degrees Celsius).
- .6 Shear and punch metals cleanly and accurately. Remove burrs.
- .7 Ease exposed edges to a radius of approximately 0.8 mm (1/32 inch), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- .8 Remove sharp or rough areas on exposed traffic surfaces.
- .9 Weld corners and seams continuously to comply with American Welding Society (AWS) recommendations, and the following:
  - .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - .2 Obtain fusion without undercut or overlap.
  - .3 Remove welding flux immediately.
  - .4 At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- .10 Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- .11 Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- .12 Shop Assembly: preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- .13 Cut, reinforce, drill and tap miscellaneous metalwork as indicated to receive finish hardware, screws, and similar items.
- .14 Ensure exposed welds are continuous for length of each joint.
- .15 Grind or file exposed welds and steel sections smooth and flush with adjacent surfaces. Weld locations not to be visible after application of paint finishes.

- .16 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .17 Accurately form connections with exposed faces flush; mitres and joints tight.
- .18 Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- .19 All welding is to be performed by CWB Certified Welders.
- .20 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush; to NOMMA Guidelines 1: Joint Finishes: Finish #1 - Ornamental Quality, No Evidence of a Welded Joint.
- .21 Fabricate work square, true straight and accurate to required size, with joints closely fitted and properly secured.
- .22 Where work of other Sections is attached to work of this section, prepare work by drilling and tapping holes as required facilitating installation of such work.

## **2.4 EXTERIOR BOLLARDS**

- .1 Pipe Bollards:
  - .1 Fabricate pipe bollards from Schedule 40 steel pipe.
  - .2 Concrete Fill: comply with requirements of Division 03 cast-in-place concrete.
  - .3 Bollard and concrete footing dimensions and design details as per Drawings.
  - .4 Finish: hot dipped galvanised after fabrication (705 g/m<sup>2</sup>) at all surfaces, exterior and interior; galvanized surface to be properly prepared for painting; primer and finish painting in accordance with Section 09 91 00 – Painting; colour as selected by Consultant at a later date.

## **2.5 ROUGH HARDWARE**

- .1 Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required. Fabricate items to sizes, shapes, and dimensions required.

## **2.6 MISCELLANEOUS FABRICATIONS**

- .1 Provide HSS framing, hot dipped galvanized after fabrication, as required for garbage enclosure and mechanical enclosure/framing.
- .2 Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required. Fabricate items to sizes, shapes, and dimensions required.
- .3 Miscellaneous Framing and Supports: Provide steel framing and supports for applications indicated as required to complete work.
- .4 Signage support: Fabricate anchors, hangers, suspension and support for signage as indicated. Provide temporary spacers where required for maintaining correct placement during construction. Signage support shall be smooth steel members.
- .5 Support framing for suspended toilet partitions: Structural channel and angle framing continuously welded and securely anchored to structure above. Design framing and anchorage to support assembly dead loads and live loads, and lateral loads attributable to misuse and vandalism. Finish: Prime painted.
- .6 Sleeves:

- .1 Supply pipe sleeves to respective trade for building in. Where required install pipe sleeves as they pass through walls, floors and ceilings.
- .2 Size sleeves to clear insulated surfaces, pipes and conduits with 13 mm minimum, unless noted otherwise.
- .3 Terminate sleeves flush with surfaces of walls and ceiling and extend 38 mm above floors, unless noted otherwise.
- .4 Seal and make waterproof and watertight sleeves of type suitable for application after installation of conduit or conductors.
- .5 For sleeves, other than waterproofed sleeves seal or pack void between sleeve and pipe, conduit, or penetrations in accordance with ULC requirements for hourly rating of surface being penetrated.
- .7 Anchors and Fastening:
  - .1 Provide all anchor bolts and expansion bolts or other means of anchorage required for building into floors, walls and ceilings, where necessary to secure metal and wood to concrete, masonry or steel work, other than anchorages specified under other Sections. Fasten all components and items securely. Provide adequate reinforcing to ensure safe rigid installation. Set anchor bolts in locations indicated and spaced as shown or, if not shown, as may be required for properly securing Work.
  - .2 Use weld studs of size not larger than 10 mm for attaching miscellaneous materials and equipment to building steel. If weight of item requires larger fasteners use clips or brackets and secure by welding or through bolting.
  - .3 Use self-drilling expansion type concrete anchors for attaching to masonry and concrete.
  - .4 Do not secure items to steel deck.
  - .5 Use steel beam clamps of 2 bolt design to transmit load to beam web. Do not use 'C' and 'I' clamps.
- .8 Inserts and Hangers:
  - .1 Install inserts, hangers, and supports. Make inserts drilled lug or expansion type.
  - .2 Before openings are cut through structure, obtain Consultant's written acceptance for procedures, locations and reinforcements required.
  - .3 Do not weld hangers to structural steel members or burn holes in structural steel.
  - .4 Do not suspend items from steel decking.
- .9 Mechanical Equipment Supports:
  - .1 Coordinate with the requirements indicated on the mechanical Drawings and Specifications.
  - .2 Design supplementary steel structures to support mechanical equipment in locations and elevations indicated on the Drawings.
  - .3 Obtain dimensions and weights of equipment from reviewed architectural and mechanical shop drawings and product data.
  - .4 Arrangement in accordance with Drawing details where indicated, and in accordance with partition and equipment supplier's recommendations.
  - .5 Submit shop drawings of support for each type and size of partition and equipment, designed, reviewed and sealed by a professional engineer. Information should include:
    - .1 Partition and Equipment loads and connections.
    - .2 Connect details to building structure.
    - .3 Locations of partitions and equipment.

- .4 Loads at each connection point to building structure.
- .6 Refer to technical specification Sections for particular requirements. Mechanical equipment requiring supplementary steel supports include but are not limited to:
  - .1 Piping.
  - .2 Equipment support beams.
  - .3 Ductwork.
- .10 Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitred joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- .11 Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
- .12 Miscellaneous Steel Trim: Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination for assembly and installation with other work.

## **2.7 CHANNEL FRAMES**

- .1 Fabricate frames from steel, sizes of channel and opening as indicated.
- .2 Weld channels together to form continuous frame for jambs and head of openings, sizes indicated.

## **2.8 MECHANICAL AND GARBAGE ENCLOSURES AND PATIO FENCE**

- .1 Supply steel HSS members and steel angles as noted on Drawings to enclosure fabricator/erector. Assume steel angle cross-bracing.
- .2 Include drilled holes in steel as required for mounting and attachment of pressure treated wood boards, bottom and top caps, and fascia, and for attaching gate hinges as required.
- .3 Coordinate and cooperate with enclosure fabricator as necessary to ensure holes in steel are installed at the correct locations and diameters, or correct sizes if slotted holes are required by the enclosure fabricator, and meeting the construction schedule.
- .4 Finish: hot dipped galvanised after fabrication (705 g/m<sup>2</sup>) at all surfaces, exterior and interior; galvanized surface to be properly prepared for painting; primer and finish painting in accordance with Section 09 91 00 – Painting; colour as selected by Consultant at a later date.

## **2.9 STAINLESS STEEL COUNTERTOP WITH INTEGRAL SINKS**

- .1 Alternative Price Item, per Section 01 23 10, item 1.4.2 inclusive:
  - .1 Coordinate and cooperate with Section 06 40 00 and mechanical trades as required.
  - .2 Custom-fabricate stainless steel kitchen countertop, to reviewed and approved Shop Drawings, complete with integral sinks and backsplash; straight finished edges, 100 mm backsplash on back and edges, and as follows:
    - .1 Stainless steel, to ASTM A480, Type 304 alloy stainless steel, minimum 14 gauge (1.8974 mm thick).
    - .2 Finish: #4 Sanitary Finish: remove any surface defects in the metal that could allow bacteria to grow. A #4 sanitary finish shall be produced by

- polishing with a 180-240 grit belt or wheel finish softened with 120–240 grit greaseless compound or a fine non-woven abrasive belt or pad.
- .3 Coating: Oleophobic coating to prevent fingerprints on surface.
- .3 Form edges of exposed tops into a 32 mm thick channel shape with wood inserts on four edges of underside of top to facilitate anchoring to base units.
- .4 Coordinate and cooperate with other trades as required.
- .5 Backsplash and curbs formed from the same sheet as the top; top edges of curbs and backsplash formed into a channel shape.
- .6 Coat underside of tops and sinks with plastic sound deadener.
- .7 Make welds without discolouration and ground, polish, and passivate to blend with the work surface finish.
- .8 Soldering of curbs or splash rails to the top will not be permitted.
- .1 Protect surfaces of the tops with strippable plastic coating to protect the tops during shipment and installation
- .9 Refer to plumbing fixture schedule on mechanical Drawings and replace fixture type DS-1 with integral stainless-steel sink and backsplash; coordinate and cooperate with other trades as required to maintain construction schedule.
- .10 Location(s): as indicated on Drawings.
- .11 Coordinate and cooperate with other trades as required for location and sizing of holes for plumbing attachments (e.g., sink drainpipe) and fitments (e.g., faucets and soap dispensers).
- .12 General design concept as per Drawings; the images below are approximate – communicate with Consultant prior to developing Shop Drawings to confirm design expectations; submit detailed Shop Drawings for review and approval prior to fabrication:



## **2.10 FINISHES**

- .1 Stainless Steel Finish:
  - .1 #4 Sanitary Finish: remove any surface defects in the metal that could allow bacteria to grow. A #4 sanitary finish shall be produced by polishing with a 180-240 grit belt or wheel, finish softened with 120-240 grit greaseless compound or a fine non-woven abrasive belt or pad.
- .2 Prior to applying primer or other finishes, clean metal to equivalent of commercial sand blast SSPC-SP6, remove sandblast in residue.
- .3 Galvanizing (all exterior steel or steel within exterior wall assemblies): hot-dip method with minimum zinc coating of 705 g/m<sup>2</sup> conforming to ASTM A123 for fabricated assemblies. ASTM A153/A153M for all hardware (average zinc coating of 381 g/m<sup>2</sup>). Hot dip galvanize after fabrication.
  - .1 The following items are to be hot dipped galvanized after fabrication:
    - .1 Steel plates and overhead door jambs and heads;
    - .2 Exterior access ladders;
    - .3 Exterior concrete-filled steel bollards;
    - .4 Other exterior steel or steel within exterior wall assemblies.
  - .2 All exposed galvanized steel shall be shop-primed and field finish painted.
- .4 Touch-up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .5 Zinc Rich Paint: Conforming to DOD-P-21035 zinc rich paint. Apply one coat of zinc rich paint to all surfaces exposed after assembly to minimum dry film thickness of 60 µm (2.5 mil). Apply coating immediately after cleaning.
- .6 Unfinished Fasteners: at interior use unfinished bolts conforming to ASTM A307, Grade A, with hexagon heads and nuts.
- .7 Shop coat primer: shall meet or exceed the requirements of CISC/CPMA 1-73 One Coat Quick Drying Primer and MPI #79 Primer, Anti-Corrosive for Metal, for use on structural steel.
- .8 Isolation Coating: bituminous paint or aerosol.
- .9 Finish paint: to Section 09 91 00 – Painting.

## **2.11 SHOP PAINTING**

- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2, minimum SSPC SP6.
- .2 Apply one coat of shop primer to metal items, with exception of galvanized or concrete encased items.
- .3 Apply two coats of primer of different colours to parts inaccessible after final assembly.
- .4 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7°C.
- .5 Do not paint surfaces to be field-welded.
- .6 Prime after fabrication and before damage to surface occurs from weather or other exposure.
- .7 Protect machine finished or similar surfaces that are not to be coated, but that do require protection, with coating of rust inhibitive petroleum, molybdenum disulphide, or other coating approved by the Consultant.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

**3.2 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2 Apply isolation coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess isolation coating "oozes out" during assembly to ensure a proper seal.
- .4 Assemble and wipe away excess product.

**3.3 ERECTION**

- .1 Erect to applicable Building Code, CSA S16, and Code of Standard Practice for Structural Steel.
- .2 Install in required locations using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs and railings to structure.
- .3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .4 Install Work in accordance with manufacturer's or fabricator's (as applicable) written instructions, job-specific details, and Drawings.
- .5 Do welding work in accordance with CSA W59 unless specified otherwise.
- .6 Supply finished items to be built in to those trades along with instructions for proper installation.
- .7 Apply architectural metalwork using hidden mechanical fasteners. Installation shall be by skilled Architectural metalworkers experienced in highest quality work.
- .8 Fasteners to draw adjoining sections together in proper, true alignment, and are capable of field adjustment.
- .9 All fasteners, mountings to be non-loosening and installed so that they will be hidden at completion.
- .10 Install all Work to true, straight lines, accurate to profile, all properly aligned.
- .11 Isolate dissimilar metals in a manner approved by the Consultant to prevent electrolytic action or corrosion.
- .12 Install finish hardware supplied under other Sections required for completion of components of this Section.

- .13 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .14 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .15 Make field connections with high tensile bolts to CSA S16 and weld to prevent loosening.
- .16 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .17 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

### **3.4 STAINLESS STEEL COUNTERTOP WITH INTEGRAL SINKS**

- .1 After fabrication, supply completed work to architectural woodwork contractor for integration with the Work of Section 06 40 00 Architectural Woodwork.
- .2 Coordinate and cooperate as required to maintain construction schedule, proper sequencing of the work, and timely delivery to location as identified by architectural woodwork contractor.

### **3.5 MISCELLANEOUS ITEMS**

- .1 Supply and install miscellaneous metal fabrications as indicated or specified, or as otherwise required in accordance with the design intent of the project.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.8 SCHEDULE**

- .1 The schedule given hereunder shall not be considered to represent a complete schedule of all metal fabrications required in the Work. Thorough scrutiny of the complete Contract Documents is required to obtain a complete schedule of metal fabrications required in the Work.
- .2 Include miscellaneous framing and supports that are not included under work indicated on structural drawings.
- .3 All exterior metal fabrications to be hot dipped galvanized after fabrication. Prime and finish paint materials exposed to view after fabrication.



- .4 Provide the following metal fabrications:
  - .1 Metal Fabrications Shown on Structural Drawings:
    - .1 Refer to structural design Drawings; fabrication work includes, but is not necessarily limited to, the following:
      - .1 Masonry support steel where not provided by Section 04 22 00; coordinate and cooperate as required;
      - .2 Additional steel fabrications shown on the structural design Drawings.
  - .2 Steel angle at perimeter of louvres and exterior metal doorframe openings.
  - .3 Structural supports and reinforcement for interior stud partitions, handrails and guardrails.
  - .4 Vanity and counter support framing.
  - .5 Structural support (blocking) for wall-mounted equipment, casework and washroom accessories.
  - .6 HSS support and reinforcement.
  - .7 Steel angle support and reinforcement.
  - .8 Steel angle or bent steel plate jambs at curtain wall, windows, and entrance framing.
  - .9 Plate surrounds at overhead door openings; 6 mm thick steel plate.
  - .10 Lateral support angles at top of masonry partitions and walls in accordance with details on structural drawings where not provided by Section 04 22 00.
  - .11 Miscellaneous steel angles, plates, and lintels required but not included on structural Drawings.
  - .12 Stainless steel countertop with integral sinks.
  - .13 Stainless steel fabrications as indicated on Drawings and not specifically covered in other Sections.
  - .14 Other metal fabrications indicated on Drawings and not specifically covered in other Sections.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section specifies requirements for stairs, guardrails (balustrades) and handrails.

**1.2 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Section 05 50 00 – Metal Fabrications.
- .3 Section 09 65 00 – Resilient Flooring.
- .4 Section 09 91 00 – Painting.
- .5 Section 13 34 19 – Pre-engineered Metal Building RFQ.

**1.3 REFERENCES**

- .1 American Welding Society (AWS)
  - .1 AWS D1.6/D1.6M:2017, Structural Welding Code - Stainless Steel.
  - .2 AWS D18.1/D18.1M:2020, Specification for Welding of Austenitic Stainless Steel Tube and Pipe Systems in Sanitary (Hygienic) Applications.
- .2 ASTM International (ASTM)
  - .1 ASTM A53/A53M-24, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .4 ASTM A269/A269M-24, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .5 ASTM A276/A276M-25, Standard Specification for Stainless Steel Bars and Shapes
  - .6 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .7 ASTM A312/A312M-24b, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .8 ASTM A480/A480M-25, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .9 ASTM A500/A500M-23, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - .10 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .11 ASTM A747/A747M-23, Standard Specification for Steel Castings, Stainless, Precipitation Hardening.
  - .12 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .13 ASTM A1064/A1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - .14 ASTM D1187/D1187M-97(2024), Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

- .15 ASTM E488/E488M-22, Standard Test Methods for Strength of Anchors in Concrete Elements.
- .16 ASTM F593-24, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- .17 ASTM F3125/F3125M-23, 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
- .3 Canadian Institute of Steel Construction (CISC)
  - .1 Code of Standard Practice for Structural Steel, 2010.
  - .2 Guide for Specifying Architecturally Exposed Steel, 2<sup>nd</sup> Edition.
  - .3 Handbook of Steel Construction – 11<sup>th</sup> Edition.
  - .4 Limit States Design in Structural Steel, 9<sup>th</sup> Edition.
  - .5 Steel Fabrication Quality Systems Guideline, 2<sup>nd</sup> Edition with Commentary.
- .4 CSA Group (CSA)
  - .1 CSA A3000-18, Cementitious materials compendium.
  - .2 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .3 CSA S16:19, Design of steel structures.
  - .4 CSA W47.1:19, Certification of companies for fusion welding of steel.
  - .5 CSA W48-18, Filler metals and allied materials for metal arc welding.
  - .6 CSA W59:24, Welded steel construction
- .5 National Association of Architectural Metal Manufacturers (NAAMM)
  - .1 NAAMM AMP 510-92, Metal Stairs Manual
  - .2 NAAMM AMP 521-01, Pipe Railing Systems Manual
- .6 National Ornamental & Miscellaneous Metals Association (NOMMA)
  - .1 NOMMA Guideline 1: Joint Finishes, 1994.
- .7 Steel Structures Painting Council (SSPC), Systems and Specifications Manual, Volume 2.
- .8 Ontario Building Code (OBC).

#### **1.4 PRE-INSTALLATION MEETINGS**

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and appropriate effected trades in accordance with Section 01 31 19 - Project Meetings to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building trades.

#### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Section 0-1 33 00 -Submittal Procedures.
- .2 Submit product data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheets.

- .3 Submit Engineered Shop Drawings:
  - .1 Indicate construction details, sizes of metal sections, and thickness of metal materials. Include connections to other materials.
  - .2 Indicate fasteners, welds and connection details between stringers; treads; risers; headers; newels; platforms; struts, columns and hangers; railings; balusters; pickets; handrails; brackets; reinforcements; anchors; and welded and bolted connections.
  - .3 Submit Shop Drawings bearing the stamp of a qualified professional engineer (P.Eng.) licenced to practice in the Province of Ontario.
    - .1 Design for post-disaster importance factors listed in OBC for deflection and strength, and as per OBC commentaries as required.
    - .2 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.

## 1.6 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.
- .3 Qualifications:
  - .1 Use a fabricator experienced in producing metal fabrications similar to those indicated for this Project and with a minimum 5-year record of successful in-service performance, as well as sufficient production capacity to produce required units.
  - .2 Welders shall be qualified by Canadian Welding Bureau for classification of Work being performed.
  - .3 Welding of load supporting components shall be performed by companies certified by Canadian Welding Bureau in accordance with CSA W47.1.
- .4 Delegated Design, to Section 01 35 01 – Delegated Design:
  - .1 Retain a Professional Engineer, licenced to practice in the Province of Ontario, to design fabrication and erection of the work of this section in accordance with Ontario Building Code, errata and amendments, and the requirements of this specification section; sign and seal shop drawings and design submittals; review installations.
    - .1 Design for post-disaster importance factors listed in OBC for deflection and strength, and as per OBC commentaries as required.
- .5 Stainless steel:
  - .1 Welding of stainless steel shall be by the electric arc process.
  - .2 Weld stainless steel by the electric arc process, to CSA W59.
  - .3 Use electrodes compatible with and of the same properties as the stainless steel. Grind smooth and polish to match finish.
  - .4 Structural stainless steel welding: to AWS D1.6/D1.6M.
  - .5 Stainless steel tube and pipe: to AWS D18.1/D18.1M.
  - .6 Joint finish requirements: to NOMMA Guidelines 1: Joint Finishes: Finish #1 - Ornamental Quality, No Evidence of a Welded Joint.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Store materials in a location and manner to avoid damage; stack materials to prevent bending or applying stress to components; keep handling of materials on-site to a minimum.
- .2 Store components and materials in clean, dry location, away from uncured concrete or masonry; cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that permits air circulation inside of covering.
- .3 Correct damaged material and where damage is deemed irreparable by the Owner, replace the affected item at no additional expense to the Owner.
- .4 Apply protective covering to face of all exposed finished metalwork before it leaves shop, covering to remain until item installed and ready for final finishing.
- .5 Fabricate large assemblies so they can be safely and easily transported and handled to their place of installation.

## **1.8 WARRANTY**

- .1 Contractor agrees to correct any deficiencies found in Work performed for a period of 5-years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 PERFORMANCE AND DESIGN CRITERIA**

- .1 Provide delegated design as required.
- .2 Design Requirements:
  - .1 Design metal construction and connections in accordance with Ontario Building Code and amendments for vertical and horizontal live load requirements.
    - .1 Design for post-disaster importance factors listed in OBC for deflection and strength, and as per OBC commentaries as required.
  - .2 Detail stairs to NAAMM AMP 510.
  - .3 Detail pipe railings to NAAMM AMP 521.
- .3 Comply with CISC Code of Standard Practice for Structural Steel, Appendix I, Architecturally Exposed Structural Steel.
- .4 Fabricate and finish guardrails and railings in accordance with CISC Guide for Specifying Architecturally Exposed Steel: to AESS 3 *Feature Elements* (see Table 1 – AESS Category Matrix).

### **2.2 MATERIALS**

- .1 Carbon Steel:
  - .1 Steel channels, angles and plates: to CSA G40.20/G40.21, Grade 300W.
  - .2 Hollow structural sections: to CAN/CSA G40.20/G40.21, Grade 350W, Class C.
  - .3 Rolled steel sections: to CSA G40.21, 350W.
  - .4 Steel pipe: to ASTM A53/A53M standard weight (Schedule 40).
- .2 Stainless Steel:
  - .1 Sheet, Strip, Plate and Flat Bar: In accordance with ASTM A480/A480M, Type 304, having #6 non-directional satin finish.

- .2 Pipe: In accordance with ASTM A312/A312M, Type 304, #6 non-directional satin finish.
- .3 Bars and Shapes: In accordance with ASTM A276/A276M, extruded shapes and sizes as shown on Drawings, having #6 non-directional satin finish.
- .4 Stainless steel fasteners, washers and nuts: to ASTM F593, type 316 austenitic stainless steel, sized as required for purpose intended, or as otherwise indicated. Cold Finished Materials: Condition B, cold worked, to ASTM A276. Exposed Fasteners: Stainless steel countersunk screws or bolts, consistent with design intent.
  - .1 Anchors shall be fabricated from stainless steel with capability to sustain, without failure, load imposed within a safety factor of 4, as determined by testing to ASTM E488.
- .3 Welding materials: to CSA W59.
- .4 Welding electrodes: to CSA W48 Series.
- .5 Fasteners: bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws, and machine bolts.
  - .1 Unfinished fasteners: In areas not exposed to the public, use unfinished bolts conforming to ASTM A307, Grade A, with hexagon heads and nuts. Supply bolts of lengths required to suit the thickness of the material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.
  - .2 Finished fasteners:
    - .1 In areas exposed to public use, bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts to be hot dip galvanized in accordance with ASTM A153/A153M.
    - .2 For joining stainless steel components use stainless steel fasteners of same type.
  - .3 Structural bolts: to ASTM F3125.
- .6 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

## **2.3 CONCRETE FILL AND REINFORCING MATERIALS**

- .1 Concrete materials and properties shall be in accordance with specified requirements in Section 03 30 00 – Cast-in-Place Concrete, and as follows:
  - .1 Concrete: Normal weight, ready mixed concrete conforming to CSA A3000, and having minimum 20 MPa compressive strength at 28 days, and total air content of not less than 4% or more than 6%.
  - .2 Non-slip aggregate finish: Factory packaged abrasive aggregate made from fused, aluminum-oxide grit; rustproof and non-glazing; unaffected by freezing, moisture, or cleaning materials.

## **2.4 CONCRETE FILLED STEEL PAN STAIRS**

- .1 Fabricate stairs with steel pan construction as detailed on Drawings.
- .2 Provide angles for fastening to channel stringers, where applied finish is indicated for underside of stairs and landings.
- .3 Form wall and outer stringers as indicated on Structural Drawings.
- .4 Extend stringers around mid landing for steel base.
- .5 Close ends of stringers where exposed.

- .6 Finish stairs in accordance with NAAMM AMP 510, commercial class.

## 2.5 HAND RAILINGS AND GUARDRAILS

- .1 **Base Bid Price:** fabricate guardrails and hand railings from carbon steel, finished as specified in this Section.
- .2 Fabricate and finish railings and guardrails in accordance with CISC Guide for Specifying Architecturally Exposed Steel: to AESS 3 Feature Elements (see Table 1 – AESS Category Matrix). Painted finish.
- .3 Shop and field connections, to CSA S16.
- .4 Cap and weld exposed ends of balusters and handrails.
- .5 Terminate at abutting wall with end flange.
- .6 Exit Stair Requirements: construction details, fabrication and erection must comply with OBC and reviewed engineered Shop Drawings.
- .7 Rolled members shall be fully shaped in the shop and tied during shipping to prevent stress relieving; distortion of the web or stem, and of outstanding flanges or legs of angles will be visibly acceptable to the Consultant when viewed from a distance of 6100 mm under any lighting condition; tolerances for the vertical and horizontal walls of rectangular HSS members after rolling shall be  $\pm 13$  mm.
- .8 Seal weld open ends of round and rectangular hollow structural section with 10 mm closure plates; provide continuous, sealed welds at angle to gusset plate connections and similar locations where exposed steel is exposed to weather.
- .9 Fabricate work square, true straight and accurate to required size, with joints closely fitted and properly secured.
- .10 Where work of other Sections is attached to work of this section, prepare work by drilling and tapping holes as required facilitating installation of such work.
- .11 **Alternate Price Item:** instead of primed and finish painted carbon steel handrails, fabricate with Type 304 stainless steel; Joint finish requirements: to NOMMA Guidelines 1: Joint Finishes: Finish #1 - Ornamental Quality, No Evidence of a Welded Joint.
- .12 **Alternate Price Item:** instead of primed and finish painted carbon steel guardrails, fabricate with Type 304 stainless steel; Joint finish requirements: to NOMMA Guidelines 1: Joint Finishes: Finish #1 - Ornamental Quality, No Evidence of a Welded Joint.

## 2.6 ACCESSORIES

- .1 Handrails and Wall Brackets: constructed of same material and finish as railing with rod and mounting flange, purpose-made to suite application and site conditions.
- .2 Sealant: in accordance with Section 07 92 00 – Joint Sealants.
- .3 Resilient one-piece tread-risers: to Section 09 65 00 - Resilient Flooring.

## 2.7 FINISHES

- .1 Prior to priming steel, prepare all surfaces in conformance with SSPC SP-3 Power Tool Cleaning for non-exposed locations and SSPC SP-5 White-metal Blast Cleaning for exposed architectural finished locations. Adjust blast grit to suit primer coat thickness.
- .2 Galvanizing (all exterior steel or steel within exterior wall assemblies): hot-dip method with minimum zinc coating of 705 g/m<sup>2</sup> conforming to ASTM A123 for fabricated assemblies. ASTM A153/A153M for all hardware (average zinc coating of 381 g/m<sup>2</sup>). Hot dip galvanize after fabrication.

- .1 The following items are to be hot dipped galvanized after fabrication:
  - .1 Steel plates and overhead door jambs and heads;
  - .2 Exterior access ladders;
  - .3 Exterior concrete-filled steel bollards;
  - .4 Other exterior steel or steel within exterior wall assemblies.
- .2 All exposed galvanized steel shall be shop-primed and field finish painted.
- .3 Touch-up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .4 Zinc Rich Paint: Conforming to DOD-P-21035 zinc rich paint. Apply one coat of zinc rich paint to all surfaces exposed after assembly to minimum dry film thickness of 60  $\mu$ m (2.5 mil). Apply coating immediately after cleaning.
- .5 Unfinished Fasteners: at interior use unfinished bolts conforming to ASTM A307, Grade A, with hexagon heads and nuts.
- .6 Primers and finish paints: to Section 09 91 00 - Painting, minimum 3-coat Premium Grade.
- .7 Emulsified asphalt protective coating for dissimilar metals: to ASTM D1187/D1187M.

## **2.8 SHOP PAINTING**

- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2, minimum SSPC SP6.
- .2 Apply two coats of primer of different colours to parts inaccessible after final assembly.
- .3 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, and grease. Do not paint when temperature is below 7°C.
- .4 Do not paint surfaces to be field welded.

## **2.9 FABRICATION**

- .1 Fabricate and finish railings and guardrails in accordance with CISC Guide for Specifying Architecturally Exposed Steel: to AESS 3 *Feature Elements* (see Table 1 – AESS Category Matrix).
- .2 Fabricate in compliance with Ontario Building Code and amendments.
- .3 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .4 Accurately form connections with exposed faces flush; mitres and joints tight. Make risers of equal height.
- .5 Shop-fabricate fabrications in sections as large and complete as practicable.
- .6 Insulate dissimilar materials to prevent electrolysis arising from metal to metal contact or metal to masonry or concrete contact; use bituminous paint or other acceptable method acceptable to Consultant.



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**Part 3            Execution**

**3.1               PREPARATION**

- .1    Provide anchorage devices and fasteners to other trades as necessary for securing fabrications to structure; include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors as required.
- .2    Perform cutting, drilling, and fitting required for erection.
- .3    Field check and verify that structural framing, enclosures, weld plates, blocking, and that size and location of pockets are placed in accordance with engineered and stamped shop drawings.
- .4    Report discrepancies to Consultant, and recommend corrective action by responsible parties.
- .5    Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- .6    Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates and instructions for installation.

**3.2               ISOLATION COATING**

- .1    Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2    Apply coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3    Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess isolation coating “oozes out” during assembly to ensure proper seal.
- .4    Assemble and wipe away excess product.

**3.3               ERECTION**

- .1    Erect to OBC, CSA S16, Code of Standard Practice for Structural Steel, and reviewed engineered Shop Drawings.
- .2    Install plumb and true in required locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting fabrications to structure.
- .3    Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .4    Do welding work in accordance with CSA W59 unless specified otherwise.
- .5    Touch-up shop primer and galvanized finish to bolts, welds, and burned or scratched surfaces at completion of erection.

### **3.4 INSTALLATION OF STAIRS**

- .1 Install in accordance with NAAMM Metal Stair Manual, OBC and reviewed engineered Shop Drawings.
- .2 Install metal pan treads, stringers, landings, hanger assemblies, closures, balustrades, handrails, and guards, level, plumb, square, complete, accurately fitted, with tight joints and intersections, in the proper locations and positions, structurally sound, securely fastened, and free from detrimental defects. Weld connections between handrails and balusters and in lengths of handrails. Weld balustrades to steel stairs or steel plates as required. Secure wall handrails to walls.
- .3 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
- .4 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .5 Do welding work in accordance with CSA W59 unless specified otherwise.
- .6 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.
- .7 Fill pans with concrete in accordance with this section and Section 03 30 00 – Cast-in-Place Concrete and provide steel trowel finish.
- .8 Repair damage to adjacent materials caused by metal stairs installation.

### **3.5 INSTALLATION OF GUARDRAILS AND HAND RAILS**

- .1 Install in accordance with NAAMM AMP 521, OBC and reviewed engineered Shop Drawings.
- .2 Install guardrails and hand rails as indicated, including all brackets, sleeves, anchors and connections. Prepare steel, and shop prime exposed components. Field prime as required to maintain cover of exposed steel.
- .3 Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
  - .1 Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-metallic grout, mixed and placed to comply with anchoring material manufacturer's directions.
  - .2 Anchor posts and rail ends to steel with welded connections, unless otherwise indicated.
  - .3 Anchor posts and rail ends into concrete and masonry with steel round flanges welded to post and rail ends, and anchored into wall construction with expansion shields and bolts.
  - .4 Install removable railing sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.
- .4 Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 50 mm clearance from inside face of handrail and finished wall surface. Locate brackets at spacing not less than 1.5 m on center, unless otherwise indicated. Secure wall brackets and wall return fittings to building construction as follows:
  - .1 Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

- .2 For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
- .3 For hollow masonry anchorage, fasten brackets directly on masonry wall using toggle bolts.
- .4 For steel framed gypsum board assemblies, fasten brackets to wood blocking using lag bolts or to metal blocking using self-tapping screws, of size and type required to support structural loads.
- .5 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .6 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.8 SCHEDULE**

- .1 Install stairs, guardrails and handrails as indicated on Drawings.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1      Section 06 40 00 - Architectural Woodwork.
- .2      Section 07 62 00 - Sheet Metal Flashing and Trim.
- .3      Section 13 34 19 - Pre-engineered Metal Building RFQ

**1.2            REFERENCES.**

- .1      ASTM International (ASTM)
  - .1      ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .2      ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .3      ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  - .4      ASTM C954-22, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
  - .5      ASTM F1667/F1667M-21a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .2      American Wood Protection Association (AWPA):
  - .1      2020 AWPA Book of Standards
- .3      CSA Group (CSA)
  - .1      CSA O80 Series-21, Wood preservation.
  - .2      CSA O86:24, Engineering design in wood.
  - .3      CSA O112.9:21, Evaluation of adhesives for structural wood products (exterior exposure).
  - .4      CS O112.10:24, Evaluation of adhesives for structural wood products (limited moisture exposure).
  - .5      CSA O121:17, Douglas fir plywood.
  - .6      CSA O141:23, Canadian standard lumber.
  - .7      CSA O325:21, Construction sheathing.
  - .8      CSA S16:24, Design and construction of steel structures.
- .4      National Lumber Grading Association (NLGA):
  - .1      Standard Grading Rules for Canadian Lumber 2017.
- .5      ULC Standards (ULC)
  - .1      CAN/ULC-S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.3            DEFINITIONS**

- .1      For the purpose of this project the following definitions shall apply:
  - .1      Structural Light Framing: All horizontal and vertical load bearing framing including members indicated as "Studs" on the drawings shall be considered to be No. 2 Grade and better and shall be used throughout unless prior approval is provided by the Consultant.

- .2 Stud Framing: Vertical framing members of non-load bearing wall systems may be considered as No. 3 or Stud Grade and may only be used where the consultant gives prior approval. Use of No. 3 and Stud Grade framing material will not be allowed for any horizontal applications

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals shall meet the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's published product literature, specifications and datasheets for products incorporated into the Work of Contract.
  - .2 Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
- .3 Material Certificates:
  - .1 For dimensional lumber specified to comply with minimum allowable unit stresses, indicate species, grade, and design values for each use.
  - .2 For exposed items, omit grade stamp and provide certificates as to species, grade, stress grade, seasoning, moisture content, and other evidence as required to show compliance with the specifications.

#### **1.5 QUALITY ASSURANCE**

- .1 Lumber identification: Grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: Grade mark in accordance with applicable CSA standards.
- .3 Each board of fire-retardant treated material to shall bear the ULC label indicating Flame Spread Classification (FSC), and smoke developed ratings.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver wood products bundled or crated to provide adequate protection during transit. Inspect wood products for damage upon delivery and remove and replace damaged materials.
- .2 Store materials a minimum of 150 mm off the ground on blocking. Keep materials under cover and dry. Provide for air circulation within and around stacks and under temporary coverings.
- .3 Protect sheet materials to prevent breaking of corners and damage to surfaces.

#### **1.7 WARRANTY**

- .1 Provide manufacturer's standard limited warranty for each product supplied under the requirements of this specification Section.

### **Part 2 Products**

#### **2.1 GRADES**

- .1 Use CLS grade marked lumber conforming to the Standard Grading Rules for Canadian Lumber published by the National Lumber Grades Authority.

## **2.2 LUMBER**

- .1 Non-Load-Bearing Lumber: Stud Grade, to CSA O141, softwood, S-P-F, S4S, kiln-dried, graded and stamped in accordance with National Lumber Grading Association (NLGA) Standard Grading Rules for Canadian Lumber and as follows:
  - .1 Moisture Content: maximum 19% at time of installation.
  - .2 Maximum moisture content when used for attachment of drywall: 16%.
  - .3 Stud (No.3) Grade or better.
  - .4 For temporary enclosures as required.

## **2.3 PANEL MATERIALS**

- .1 Panels shall have no added urea formaldehyde.
- .2 Exterior grade plywood (locations requiring plywood at the exterior enclosure assemblies): exterior grade Douglas Fir (DFP), Spruce (SPF) to CSA O121, thickness as indicated; waterproof glue bond.
- .3 Fire-Rated Materials: ULC-labelled fire resistant, provide grade stamp or certification as noted for fire retardant pressure treated lumber.
  - .1 Location: backing for electrical panels.
  - .4 Fire Rated Plywood Panels, to CSA O325, Class A fire retardant produced under Performance Standard PS-1, certified by the American Plywood Association. Fire-Rated Materials: ULC-labelled fire resistant, provide grade stamp or certification as noted for fire retardant pressure treated lumber.
    - .1 Standard of Acceptance:
      - .1 Purekor Fire Retardant Plywood.

## **2.4 MISCELLANEOUS LUMBER**

- .1 Provide lumber for support or attachment of other construction, including furring, blocking, nailing strips, ground, rough bucks, cants, curbs, fascia, backing sleepers, and similar members.
- .2 Fabricate miscellaneous lumber from dimension lumber of sizes indicated, and into shapes shown on drawings.
- .3 Moisture Content: 19% maximum for lumber items not specified to receive wood preservative treatment.
- .4 Grade: for dimension lumber sizes provide No. 2 or Standard grade lumber per NLGA. For board-sized lumber, provide sheathing grade, S2S.

## **2.5 WOOD PRESSURE TREATMENTS**

- .1 Where lumber or plywood is indicated as preservative treated (P.T.) or is specified to be treated, treated in accordance with CAN/CSA O80.9M and AWWA.
- .2 Wood preservatives containing arsenic or chromium are not permitted.
- .3 Pressure tret -above ground items with waterborne preservatives to minimum retention of 4.0 kg/m<sup>3</sup>. After treatment, kiln-dry lumber and plywood to maximum moisture content of 19% and 15% respectively. Treat indicated items.
- .4 Complete fabrication of treated items before treatment where possible. If cut after treatment, apply field treatment to cut surfaces.

## **2.6 ACCESSORIES**

- .1 Sealants: in accordance with Section 07 92 00 – Joint Sealants. Maximum allowable VOC limit 250 g/L in accordance with SCAQMD Rule 1168.
- .2 General purpose adhesive: to CSA O112 Series. Maximum allowable VOC limit 70 g/L in accordance with SCAQMD Rule 1168.
- .3 Structural Adhesive: LePage PL 400, or equivalent with same or better physical, application and performance properties per technical data sheet.
  - .1 Required Application Locations: adhesive required for subfloor plywood to subfloor joists/structure.
- .4 Nails, spikes, and staples: to ASTM F1667/F1667M, double hot dipped galvanized for exterior work and pressure preservative and fire retardant treated materials; hot dipped galvanized for all other purposes.
- .5 Screws for Fastening to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- .6 Rough Hardware (bolts, nuts, washers, etc.): hot dip galvanized in conformity to ASTM A153/A153M.
- .7 Proprietary fasteners: hot dip galvanized or type 316 stainless steel toggle bolts, expansion shields and lag bolts, screws and lead plugs, recommended for purpose by manufacturer.
- .8 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.
- .9 Fabricated zinc coated steel products tested or designed in accordance with CSA O86 and CSA S16. Types and products as indicated on Drawings or as required by reviewed engineered Shop Drawings. Hot dipped galvanized after fabrication. Where exposed to view, prime and finish paint colour as determined by Consultant at a later date.
  - .1 Standard of Acceptance:
    - .1 Simpson Strong Tie Company Inc. or equivalent.
- .10 Isolation Coating: bituminous paint or aerosol.

## **2.7 FASTENER FINISHES**

- .1 Galvanizing: use hot-dipped galvanized fasteners complying with ASTM A153/A153M and connectors complying with ASTM A653/A653M, class G185, for all other applications.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Fabrication and installation work shall meet or exceed the requirements of the applicable Building Code.
- .2 Accurately frame and properly assemble rough carpentry work. Include all necessary nails or other connectors.

### **3.2 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.

- .2 Apply isolation coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess isolation coating “oozes out” during assembly (to ensure a proper seal).
- .4 Assemble and wipe away excess product.

### **3.3 PRESSURE PRESERVATIVE TREATMENT (P.T.)**

- .1 Pressure treat wood as indicated on Drawings, where exposed to weather, and at exterior enclosure assemblies.

### **3.4 INSTALLATION**

- .1 Install members true to line, levels and elevations, square and plumb.
- .2 Construct continuous members from pieces of longest practical length.
- .3 Install lumber and panel materials as indicated on Drawings, and so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .4 Use dust collectors and high-quality respirator masks when cutting or sanding wood panels.

### **3.5 ERECTION**

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.

### **3.6 FASTENINGS AND ROUGH HARDWARE**

- .1 Unless indicated otherwise, fasten to concrete surfaces with expansion shields and bolts.
- .2 Where screws are required use lead or inorganic fibre plugs. Wood or organic plugs not permitted.
- .3 Powder actuated fasteners may be used in lieu of bolts if approved by the Consultant in writing prior to materials arriving on site.
- .4 Provide all rough hardware such as nails, bolts, nuts, washers, screws, clips, and strap metal.

### **3.7 ROOFING ROUGH CARPENTRY**

- .1 Construct, erect and install plywood and lumber elements as indicated on Drawings. Plywood shall be exterior grade.
- .2 Wood elements exposed to weather and water shall be pressure preservative treated.
- .3 Unexposed wood in contact with roofing waterproofing membranes shall not be pressure preservative treated.

### **3.8 MISCELLANEOUS**

- .1 Install wood stud framing for temporary weather closures and cladding. Construct to resist wind pressures.
- .2 Install plywood shims at window openings.



**3.9 EXTERIOR CARPENTRY**

- .1 Construct exterior work using hot dip galvanized nails, screws or bolts. Bolts, nuts and washers shall be hot dip galvanized.
- .2 Plane all sides and backs; sand exposed faces and surfaces, round all edges to prevent checking of edges.
- .3 Countersink bolts and washers, fill holes with matching wood plugs.
- .4 Apply two liberal coats of clear surface applied wood preservative, allowing the first coat to soak in completely prior to applying second coat in accordance with manufacturers instructions.

**3.10 POWER, TELECOMMUNICATIONS AND DATA PANEL BOARDS**

- .1 Install 19 mm fir plywood boards on all walls in rooms receiving wiring and electrical equipment; minimum 1220 mm x 2440 mm panels on periphery walls over 300 mm wide, mounted 150 mm off of finished floor; coordinate installation and locations with electrical divisions.
- .2 Paint panels with two coats of light-coloured fire-retardant intumescent paint finish; coat all sides of panels (back, front and sides) to meet the intent of fire rated panel requirements listed in CSA T530 and ANSI/TIA/EIA 569-A requirements.

**3.11 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.12 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.13 SCHEDULE**

- .1 Fabricate, erect and install rough carpentry Work in accordance with Drawings, and as specified.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 The work of this section includes the supply and installation of custom shop-fabricated architectural woodwork in accordance with Architectural Woodwork Standards (NAAWS).
- .2 All cabinet hardware to be supplied by this section.

**1.2 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 07 92 00 – Joint Sealants.
- .3 Section 09 21 16 – Gypsum Board Assemblies.
- .4 Section 09 91 00 – Painting.
- .5 Section 10 28 10 – Toilet and Bath Accessories.
- .6 Division 22 – Mechanical.
- .7 Division 26 – Electrical.
- .8 Division 27 – Communications.

**1.3 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI A208.1-2009, Particleboard.
  - .2 ANSI A208.2-2022, Medium Density Fiberboard (MDF) for Interior Applications.
- .2 ASTM International (ASTM)
  - .1 ASTM A240/A240M-25, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, and Strip for Pressure Vessels and for General Applications.
  - .2 ASTM A480/A480M-25, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .3 ASTM A666-24, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .4 ASTM D1037-12 (2020), Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
  - .5 ASTM D2559–12a (R2018) Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
  - .6 ASTM D2832-92(2016), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
  - .7 ASTM D3574-17, Standard Test Methods for Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams.
  - .8 ASTM D3930–08(2015), Standard Specification for Adhesives for Wood-Based Materials for Construction of Manufactured Homes.
  - .9 ASTM D4300-01(2021)e1, Standard Test Methods for Ability of Adhesive Films to Support or Resist the Growth of Fungi.
  - .10 ASTM D5116-17, Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.

- .11 ASTM D5672/D5673M-15, Standard Test Method for Testing Flexible Cellular Materials Measurement of Indentation Force Deflection Using a 25-mm (1-in.) Deflection Technique.
- .12 ASTM E1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.
- .3 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
  - .1 (NAAWS) North American Architectural Woodwork Standards, v 4.0, 2021, including Errata.
- .4 California Air Resources Board (CARB)
  - .1 Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products (2007).
- .5 CSA Group
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .2 CAN/CSA O80 Series-15 (R2020), Wood Preservation, Includes Update No. 1 (2017) and Update No. 2 (2019).
  - .3 CSA O112.9-10(R2019), Evaluation of Adhesives for Structural Wood Products (Exterior Exposure), Includes Update No. 1 (2011).
  - .4 CSA O112.10-08 (R2017), Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure), Includes Update No. 1 (2010), Update No. 2 (2010).
  - .5 CSA O115-M1982(R2001), Hardwood and Decorative Plywood.
  - .6 CSA O121-17, Douglas Fir Plywood.
  - .7 CSA O141-05 (R2019), Softwood Lumber.
  - .8 CSA O151-17, Canadian Softwood Plywood.
- .6 International Organization for Standardization (ISO)
  - .1 ISO 14040:2006, Environmental Management-Life Cycle Assessment - Principles and Framework.
  - .2 ISO 14041:1998, Environmental Management-Life Cycle Assessment - Goal and Scope Definition and Inventory Analysis.
- .7 National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA LD-3-2005, High-Pressure Decorative Laminates (HPDL).
- .8 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 2017.
- .9 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
  - .1 SCAQMD Rule 1113-16, Architectural Coatings.
  - .2 SCAQMD Rule 1168-17, Adhesive and Sealant Applications.
- .10 ULC Standards
  - .1 CAN/ULC-S102-10, Standard Method for Surface Burning Characteristics of Building Materials and Assemblies.

#### **1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings:
  - .1 Show location of each item, dimensioned plans and elevations, large scale details, attachment devices, and other components.
  - .2 Show details of construction, profiles, jointing, fastening and other related details.
  - .3 Show materials, thicknesses, finishes and hardware.
- .3 Samples:
  - .1 Submit two finished samples, 610 mm x 610 mm, for each finish to be applied, to the Consultant for approval. Where materials are being matched, verify that specified materials match existing prior to submitting samples.
  - .2 Reviewed samples shall become the standard for the work upon acceptance.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Project Record Sheet: Submit to the Consultant two copies of project record sheet identifying project title and address, Owner, Consultant, and Architectural Woodwork Subcontractor. Indicate materials and finishes used for architectural woodwork and whether shop finished, or site finished and by whom. Include type and source of cabinet hardware and special items used under architectural woodwork.
- .2 Submit in accordance with the requirements of Section 01 78 23 - Operating and Maintenance Manual.

#### **1.6 QUALITY ASSURANCE**

- .1 Architectural Woodwork Standards (NAAWS) and Errata shall be used to establish the minimum level of quality for this project.
- .2 Execute the work of this Section by a member of AWMAC with five years' experience in work of comparable complexity and scope.
- .3 Any reference to Custom or Premium grade in this specification shall be as defined in the NAAWS.
- .4 Any item not given a specific quality grade shall be Custom grade as defined in the NAAWS.
- .5 A copy of the NAAWS shall be made readily available for reference purposes on the job site.
- .6 References in this specification to part and item numbers mean those parts and items contained within the NAAWS.
- .7 Perform the Work in accordance with the definition of 'Good Workmanship' as defined in the NAAWS.
- .8 Provide Consultant and Owner with an opportunity, at no additional cost to Contract, to view previous cabinetry work of similar type as required for this project completed in the past five years.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store, and handle materials in accordance with the NAAWS. Control the temperature and humidity in accordance with NAAWS recommendations, before, during, and after delivery, during storage, and during and after installation as required.

- .1 Do not deliver architectural woodwork fabrications to site if temperature and humidity are not acceptable and do not meet AWMAC guidelines. The Contractor and affected trades shall cooperate and work together to ensure that the environment into which the Work will be installed is suitable and meets AWMAC recommendations.
- .2 Provide protective coverings of suitable material for plastic laminate items, taking special precautions to protect corners.
- .3 Do not permit delivery of millwork to the site until the area is sufficiently dry so that woodwork shall not be damaged by excessive changes in ambient humidity.

## **1.8 SITE CONDITIONS**

- .1 Comply with the NAAWS requirements for care and storage for optimum temperature and humidity conditions. Maintain a minimum 430 lx (40 f.c.) illumination on surfaces and areas where work is being installed.
- .2 Where work is indicated to be fitted to other construction, check dimensions of other construction by field measurement before fabrication; show recorded field measurements on final Shop Drawings. Coordinate fabrication schedule with construction schedule and progress to avoid delay of Work.
- .3 Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

## **1.9 WARRANTY**

- .1 Provide manufacturer's standard ten-year limited warranty for solid and quartz surfacing against defects in materials and workmanship; including material and labour to repair or replace defective materials.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Use clean stock only and comply with NAAWS for quality grades specified.
- .2 Furring, Blocking, Shims, and Hanging Strips: fire-retardant-treated softwood, softwood lumber, kiln dried to less than 8% moisture content.
- .3 Lumber:
  - .1 Softwood lumber: kiln dried to maximum moisture content of 7%, dressed 4 sides in accordance with following standards:
    - .1 CSA O141.
    - .2 NLGA Standard Grading Rules for Canadian Lumber.
    - .3 AWMAC Custom grade, moisture content as specified.
  - .2 Concealed framing lumber: Eastern Spruce, Balsam Fir, or Jack Pine, to CAN/CSA O141, NLGA, and AWMAC Custom Grade, S4S, average moisture content 7%  $\pm$ 2% at installation.
  - .3 Hardwood lumber: red oak species, S4S, average moisture content of 6% and maximum of 9% for interior work, an average moisture content of 12% and maximum of 15% for exterior work, in accordance with following standards:
    - .1 National Hardwood Lumber Association (NHLA).
    - .2 NAAWS custom grade, moisture content as specified.

- .4 Medium Density Fibreboard (MDF): Meeting ASTM D1037 and ANSI A208.2, Custom Grade for interior use, minimum 700 kg/m<sup>3</sup> density; formaldehyde emissions shall be 0.30 ppm or less per 0.424m<sup>2</sup>/m<sup>3</sup> of room value.
  - .1 Urea-formaldehyde free.
  - .2 Standard of Acceptance for high moisture areas (e.g., bathrooms, next to dishwashers, toe-kicks/cabinet bases, locations where core may be exposed to water, other wet rooms and spaces exposed to frequent wetting):
    - .1 Medex MDF, Roseburg.
    - .2 Flakeboard Premier Plus Moisture Resistant MDF, Flakeboard.
  - .3 Standard of Acceptance for standard applications:
    - .1 Medite II MDF, Roseburg.
    - .2 Flakeboard Premier MDF, Flakeboard.
  - .4 Standard of Acceptance for thin paper laminates and thermally fused melamine:
    - .1 Flakeboard Premier Plus MDF, Flakeboard.
  - .5 Standard of Acceptance for fire-resistant core:
    - .1 Medite MDF FR, Roseburg.
    - .2 Flakeboard Premier MDF FR, Flakeboard.
- .5 Alternative Price Item, per Section 01 23 10, item 1.4.2 inclusive:
  - .1 Custom-fabricated stainless steel kitchen countertop complete with integral sink and backsplash: fabricated and supplied by Section 05 50 00 - Metal Fabrications for installation and incorporation into the work by Section 06 40 00.
- .6 High-Pressure Decorative Laminate (HPDL): to ANSI/NEMA LD3; Grades and application in accordance with applicable NAAWS requirements and as follows:
  - .1 Constructed of multiple layers of phenolic resin-saturated kraft paper in combination with a layer of decorative melamine-saturated paper, all fused together under heat and pressure, sealed edge method of laminating.
  - .2 Horizontal General-Purpose Grade (HGS): thickness of 1.2 mm ±0.12 mm, used on the following:
    - .1 Horizontal surfaces, unless specified otherwise.
  - .3 Vertical General-Purpose Grade (VGS): thickness of 0.7 mm ±0.10 mm, used on the following:
    - .1 Vertical surfaces, unless specified otherwise.
    - .2 Exposed portions of case bodies, including ends, divisions and bottoms.
    - .3 Exposed shelves.
    - .4 Casework Doors: exposed and semi-exposed surfaces.
    - .5 Drawer Faces: exposed and semi-exposed surfaces.
  - .4 Liner Grade (CLS): thickness of 0.5 mm ±0.10 mm, used on the following:
    - .1 Semi-exposed shelves.
    - .2 Interior portions of case bodies.
    - .3 All surfaces of drawer boxes.
  - .5 Laminate backer grade (BKL): thickness of 0.5 mm ±0.10 mm, used on the following:
    - .1 Concealed surface of casework backs.
    - .2 Concealed surfaces, unless specified otherwise.

- .6 Colours:
  - .1 Plastic Laminate surface #1 (PLAM1):
    - .1 Standard of Acceptance:
      - .1 ARBORITE, CLASSIC ARTISAN WALNUT, W2002AW
  - .2 Plastic Laminate surface #2 (PLAM2):
    - .1 Standard of Acceptance:
      - .1 ARBORITE, ELEGANT WHITE, S550 CA.
- .7 Acceptable Manufacturers:
  - .1 Wilsonart.
  - .2 Arborite.
  - .3 Formica.
  - .4 Lamin-Art.
  - .5 Nevamar.
  - .6 Pionite.
  - .7 Abet Laminati.
  - .8 Tafisa.
  - .9 Decotec/Egger.
  - .10 Aurauco.
  - .11 Design Spec Rep- Sublime Collection.
  - .12 Panolam.
- .7 Miscellaneous metal components, fasteners, bolts and hardware incorporated into casework:
  - .1 Comply with requirements of Section 05 50 00 and 05 51 00 as applicable.
  - .2 Fabricate work true to dimensions, square and plumb.
  - .3 Thickness of metal shall be adequate for the various conditions, and intended uses.
  - .4 Finished work shall be free from warping, open seams, weld marks, rattles and other defects. Drilling shall be reamed and exposed edges finished smooth.
- .8 Quartz Surface: Homogeneous mixture containing 93% pure 7% resin binders and pigments. Include this Work in Bid Price.
  - .1 Thickness: 20 mm
  - .2 Finish: polished.
  - .3 Certified by NSF International for food contact.
  - .4 Colour Basis-of-Design:
    - .1 Quartz surface 1 (QTZ1).
      - .1 Basis-of-Design:
        - .1 WILSONART, CARRARA CODENA, Q6022.
    - .2 Quartz surface 2 (QTZ2).
      - .1 Basis-of-Design:
        - .1 WILSONART, HANOLA GREY, Q4044.
- .5 Acceptable Materials:
  - .1 Caesarstone.
  - .2 Cambria
  - .3 Hanstone Quartz
  - .4 Silestone, Cosentino.

- .5 Vicostone
- .6 Corian Quartz, DuPont.
- .9 Edging:
  - .1 General: edge type shall conform to NAAWS requirements, and Drawings.
  - .2 Solid, high-impact, purified, colour-thru, acid resistant, PVC edging, as follows:
    - .1 3 mm thick at door edges only;
    - .2 3 mm thick at gables and shelves.
  - .3 Where there is no matching edge tape or edgebanding for a particular plastic laminate selection, use self-edge. Ensure self-edges are clean and minimal, with no visible seams or adhesive.
- .10 Adhesives, use commercial-grade, brush-applied adhesives only, and recommended by manufacturer for application and conditions:
  - .1 Adhesives shall contain no added urea formaldehyde.
  - .2 General Construction Adhesive:
    - .1 Standard of Acceptance:
      - .1 LePage PL Premium Construction Adhesive.
  - .3 Decorative laminate: polyvinyl acetate or aliphatic resin in accordance with manufacturer's recommendation for curing under pressure for bonding to wood cores, water-resistant type.
  - .4 Edge banding: EVA (Ethylene Vinyl Acetate) hot melt adhesive system using compatible equipment as recommended by the adhesive manufacturer. Prime the PVC bonding surface with a primer before adhering to substrate using a primer approved by the hot melt adhesive system manufacturer.
  - .5 Metal-to-Wood/MDF/Particleboard: 3M™ Marine Adhesive/Sealant 5200, or equivalent.
  - .6 Quartz Mounting Adhesive: Provide structural grade '50 year' silicone or epoxy adhesive.
    - .1 Acceptable silicone manufactures:
      - .1 Dow Corning.
      - .2 GE Sealants.
    - .2 Acceptable epoxy manufactures:
      - .1 Akemi North America.
      - .2 Bonstone Material Corporation.
      - .3 Cambria Two Part Acrylic Adhesive.
      - .4 Tenax USA.
  - .7 Quartz Surface Adhesive:
    - .1 Provide epoxy or polyester adhesive of a type recommended by manufacturer for application and conditions of use.
    - .2 Adhesive which will be visible in finished work shall be tinted to match quartz Surface.
- .11 Joint Sealants: in accordance with Section 07 92 00 – Joint Sealants.
- .12 Coarse-Thread Fasteners:
  - .1 Paulin or SPAX #8 x 1-3/4 inch (45 mm) self-tapping coarse thread screws.
  - .2 Paulin or SPAX #8 x 2-1/2 inch (64 mm) self-tapping coarse thread screws.
  - .3 Paulin or SPAX #6 x 5/8 inch (16 mm) self-tapping coarse thread screws, finish to match hardware as closely as possible.



- .13 Accessories:
  - .1 At electrical and communications outlets and penetrations at casework: Provide electrical trim ring covers (colour: as selected by Consultant).
    - .1 Standard of Acceptance:
      - .1 FastCap, or approved equivalent.
  - .2 Nails: screw nails, to ASTM F1667; hot dipped galvanized steel.
  - .3 Wood screws: hot dipped galvanized steel, type and size to suit application.
  - .4 Splines: wood.
  - .5 Screws into concrete block: Tapcon by Buildex.
  - .6 Screws and bolt caps to cover heads of fasteners used to secure cabinets to walls - pop on screw covers for 6 mm diameter screws - by Speaneur or equivalent.
  - .7 Gable connectors - joint connector bolt JCBB0101 Cx2 and joint connector cap JCN010 Cx2 by Richelieu, or equivalent.
  - .8 Floating Blind Shelf Supports, by LeeValley, or equivalent, complete with all brackets, fasteners and accessories as required for a complete installation. Mounting hardware to suit shelf length and width as required to resist loads; fasten directly to structure.
  - .9 Door and drawer bumpers: thin self-adhesive bumpers available from various sources.
  - .10 Isolation Coating: C.R. Laurence bituminous paint or aerosol, or equivalent.
- .14 Countertop Support Materials:
  - .1 Steel Support Framing: Refer to Section 05 50 00 – Metal Fabrications, fabricate steel support framing to support weight of solid surfacing and quartz surface stone materials and to account for cut outs and openings required for installation.
  - .2 Wood Core: Fabricate countertop core from shop-sanded exterior grade veneer core plywood, no exceptions.
  - .3 Shims: Fabricator's standard shim materials to fully support stone slab on wood core to provide flat and level installation that does not transfer stresses that could cause cracking in stone slab.
  - .4 Fasteners: As recommended by manufacturer and as follows:
    - .1 Draw Bolt Fasteners: Mitre butt joint fastener, adjustable and requiring no special tools for installation, galvanized.
    - .2 Non-Exposed Fasteners: Fabricator's choice consistent with quality level specified; exposed fasteners will not be permitted.

## 2.2 WASHROOM LAVATORY STATION

- .1 SloanStone® ELC-82000 Solid Surface 2-Station Wall-Mounted Counter Top Sink.
- .2 Work includes
  - .1 supply and installation of wall-mounted 2-sink station (by casework trade); coordinate blocking in wall as required to ensure proper support of unit,
  - .2 installation of L1 fixtures as specified in mechanical Drawings plumbing fixture schedule (by plumbing trade), and
  - .3 installation of standalone soap dispenser SD-1 (by washroom accessories trade), as specified in architectural Drawings and as per Section 10 28 10 - Toilet and Bath Accessories.

## **2.3 CASEWORK AND MILLWORK CONSTRUCTION**

- .1 Work shall conform to applicable NAAWS requirements and as shown on Drawings.
- .2 The following summary takes precedence and governs the Work; coordinate with Drawings:
  - .1 Wall hung where shown.
  - .2 Where dishwasher is provided, include moisture resistant cores and substrates (e.g. Medex).
  - .3 Sealed core construction.
  - .4 Vented drawers.
  - .5 Soft-close function at all doors and drawers.
  - .6 Bumpers on all doors and drawers.
  - .7 150 lbs. load capacity full extension undermount glides on kitchenette large drawers.
  - .8 No exposed fasteners are permissible.
  - .9 No 'speed cap' covers over exposed fasteners are permitted.
  - .10 Undermount glides on drawers. Ensure no sharp edges.
  - .11 Toe kicks and floor bases as indicated per location.
- .3 Door and Drawer Bumpers: Self-adhesive type approximately 6 mm diameter clear silicone bumpers for all cabinet work doors and drawer faces, two per door and drawer, placed at door top and bottom and drawer top.
- .4 Refer to Drawings for construction and details of casework and millwork.
- .5 All casework cores to be MDF.
- .6 All casework interiors to be melamine, excluding open shelves which will be clad with plastic laminate face material.
- .7 Provide the following minimum thicknesses:
  - .1 Doors: 19 mm.
  - .2 Drawer fronts: 19 mm.
  - .3 Gables: 19 mm.
  - .4 Cabinet backs (floor mounted): 19 mm.
  - .5 Cabinet backs (wall mounted): 19 mm.
  - .6 Shelves: 19 mm, or as otherwise specified.
- .8 Shelves spanning up to 813 mm to be minimum 19 mm thick. Shelves spanning up to 1070 mm to be minimum 25 mm thick. Reinforce shelves where span exceeds 1000 mm.

## **2.4 CABINET FABRICATION**

- .1 General:
  - .1 Cabinet doors and drawer fronts as noted on Drawings.
  - .2 Install closure strips where cabinets abut adjacent walls. Top, front and bottom closures required for upper cabinets.
  - .3 Assemble Work with flush butt hairline corners and joints. Cut-outs for services to be done on site during installation. No hairline cracks will be allowed in the face area of cabinet work modules unless approved in writing by Consultant.
  - .4 Carefully fit, cope or mitre and well glue-up joints. There shall be no end wood visible on finished surfaces.

- .5 Set nail heads in finished surfaces. Countersink screws and bolts, except those detailed to be exposed, and fill holes with edge grain wood plugs to match colour and grain.
- .6 Ensure adjacent part of continuous work match in colour and pattern.
- .7 Substrate (core) for toe-kicks to be exterior grade plywood.
- .8 Connect cabinets to one another where required with male / female compression through-bolts. Do not use screws to connect cabinets where they are linked together.
- .2 Construction: as shown on Drawings, and as follows:
  - .1 Minimum core thicknesses as follows:
    - .1 Drawer bottoms: MDF core, 12 mm, clear lacquer finish top and underside;
    - .2 Drawer sides and backs: MDF core, 12 mm, 3 mm thick PVC edging;
    - .3 Drawer fronts: MDF core, 19 mm;
    - .4 Doors: MDF core, 19 mm;
    - .5 Cabinet Bodies – all sides: MDF core; thicknesses as indicated.
    - .6 Shelves:
      - .1 Fabricate using MDF core, thicknesses as specified; exposed front edge to have 3 mm thick PVC edging.
      - .2 Shelves spanning up to 813 mm to be minimum 19 mm thick.
      - .3 Shelves spanning between 813 mm and 1070 mm to be minimum 25 mm thick.
      - .4 Reinforce shelves as required where span exceeds 1000 mm.
      - .5 Maximum permitted sag: 0.02 inch per foot (1.7 mm per metre) or less.
  - .2 Glue, dowel, mortise, lock joint or dado all cabinet work and cabinet work. Do not use staples or nails. Screws are acceptable in conjunction with 100% adhesive-bonded joints. Do not surface nail or screw through countertops.
  - .3 Blocking, framing, web frames to be solid lumber.
  - .4 Cut and adapt all Work to receive hardware.
    - .1 Drill and prepare end gables for insert type shelf standards on gables.
    - .2 Install all finishing hardware and fittings in shop.
    - .3 Fittings which may be susceptible to damage during shipping and installation may be installed after millwork installed on site.

## 2.5 CABINET HARDWARE

- .1 Provide the following cabinet hardware, in quantity required, complete with all screws, bolts, washers for complete installation.
- .2 Non-Exposed Fasteners: fabricators choice consistent with quality level specified.
- .3 Exposed Fasteners: Architectural appearance, material, finish and fastener tool type as selected by Consultant; coordinate sample submittals before ordering materials.
- .4 Draw Bolt Fasteners: Mitre butt joint fastener, adjustable and requiring no special tools for installation, galvanized.
  - .1 Standard of Acceptance:
    - .1 K&V 516, Knape & Vogt Canada.
    - .2 BP5162G, Richelieu

- .5 Spacers: Rigid PVC to size and profile indicated.
- .6 Door and Drawer Mutes/Bumpers: 6 mm diameter clear resilient nylon, adhesive back mutes, minimum 2 per door/drawer. Richelieu #BP303-11, clear. "HD1311-552" by Mepla.
- .7 Access Panel Connectors
  - .1 Standard of Acceptance:
    - .1 Type JCB-A0101C complete with Tee-Nut 261.12, Richelieu.
- .8 Grommets for electrical cords through counter tops, as indicated on drawings.
  - .1 Standard of Acceptance:
    - .1 EPD Flip-Top Series, 64 mm Ø, Mocket
    - .2 600910140, 70 mm Ø, chrome, Richelieu
    - .3 76090, 64 mm Ø, black, Richelieu
    - .4 BP6026195, 60 mm Ø, brushed nickel, Richelieu
- .9 Washroom Bench Hardware: provide Type 304 stainless steel 10M square carriage bolts with matching stainless steel hexagon nuts to secure wood to steel angles. Separate dissimilar metals with bituminous paint or aerosol.
- .10 Counter overhang brackets: Rakks EH-1416B, or equivalent, finish and colour as determined by Consultant at a later date.
- .11 Pulls: contemporary stainless steel edge pulls, by Richelieu, 100 mm, or approved equivalent.
- .12 Drawer Slides: stainless steel full extension ball bearing drawer slides with soft-close function, and 45 kg load capacity, by Richelieu, Berenson, or Accuride. Use one type from same manufacturer for all drawers.
- .13 Hinges: soft-close European style concealed hinges, by Blum, DTC, Salice or Waterson. Use one type from same manufacturer for all doors with same function.
- .14 Soft-close pull-out garbage and recycling systems, as shown on Drawings; use same manufacturer and system for both garbage and recycling units. Face panels of pull-outs to match adjacent cabinet doors.
  - .1 Standard of Acceptance:
    - .1 4WCWM Series Wood Bottom Mount Waste Management Center with Soft-Close and two 8 L containers, by Rev-A-Shelf, or equivalent by Häfele, or other comparable manufacturer.
- .15 Cabinet Locks: keyed cylinder, four keys per lock, satin nickel finish, by Olympus, Richelieu, Trimline or CompX National; use one cylinder type from same manufacturer for all locks.
- .16 Stainless steel pin rests: 7 mm Ø socket collar inserts for steel pin shelf supports, drill holes in cabinet work to accept collar, chrome or nickel finish; provide pins as required for proper support of shelves provided:
  - .1 Acceptable Materials:
    - .1 Series 331/325 grommet, Knappe & Vogt Canada.
    - .2 5829-180/2292-180, Richelieu.

## 2.6

### PRECONDITIONING

- .1 Decorative laminates and core materials should be conditioned before bonding so that all materials reach equilibrium and are neither too dry nor too damp, the latter being most important at the time of pressing. Optimum conditions are best achieved in a dry storage area (about 20°C and 50-60% Relative Air Humidity).
- .2 The sheets that will form the opposite faces of the same composite board are best conditioned as a pair, with their sanded backs together. Sheets paired in this manner should be stacked, covered, and left for a minimum period of three days in order to reach moisture equilibrium. This will ensure that they achieve near identical moisture contents prior to so that bonding, and any subsequent dimensional movements will therefore be similar in both magnitude and direction on each side of the composite panel.
- .3 Wood-based core materials should have a moisture content of around 9%. The moisture content of laminates cannot be measured with a normal moisture meter, but it is essential that the face laminate has the same moisture content as the corresponding backing board.
- .4 Panels and boards faced with decorative laminate will nearly always be required to have the reverse side faced with a similar material to counter-balance the effects of dimensional changes that may take place.

## **2.7 FABRICATION – GENERAL**

- .1 NAAWS Quality Grade: Custom.
- .2 Conform to the design intent and requirements of Section 09 99 00 – Finishes List.
- .3 Shop fabrication and site installation shall take into account and properly accommodate plumbing and electrical work to be incorporated into the cabinetry work and cooperate and coordinate with other trades as required to maintain the construction schedule.
- .4 Case body: glue and dowel joints.
  - .1 Glued dado / tenon construction is acceptable using a structural wood glue, such as the specified LePage PL Custom Construction Adhesive. Screws at non-visible locations can be used in addition to adhesive bonding, but not instead of adhesive bonding.
- .5 Blocking, framing, web frames to be solid lumber.
- .6 Drawer fronts to be securely fastened to drawer boxes.
- .7 Drawer bottom to be captured in 9 mm standing shoulders on all four sides, or captured in front and two sides with #8 screws at 100 mm on centre on the back edge with screw nails between, or captured on two sides and secured with screws and screw nails on front and back.
- .8 Flush overlay cabinet doors and drawer fronts as detailed.
- .9 Permanent non-adjustable shelving: tenon-and-groove joints, same material and finish as case body.
- .10 Assemble Work with flush butt hairline corners and joints. Cut-outs for services to be done on site during installation. No hairline cracks will be allowed in the face area of cabinet work modules.
- .11 Carefully fit, cope or mitre and well glue-up Joints. There shall be no end wood visible on finished surfaces.
- .12 Set nail heads in finished surfaces. Countersink screws and bolts, except those detailed to be exposed, and fill holes with edge grain wood plugs to match colour and grain.
- .13 Blocking, framing, web frames to be solid lumber.

- .14 Provide solid wood edge strips in all doors and cases to receive hardware. Rebate and pressure glue to core.
- .15 Cut and adapt all Work to receive hardware.
  - .1 Drill and prepare end gables for insert type shelf standards on gables.
  - .2 Install all finishing hardware and fittings in shop.
  - .3 Fittings which may be susceptible to damage during shipping and installation may be installed after millwork installed on site.
- .16 Ensure adjacent part of continuous work match in colour and pattern.
- .17 Ensure counter edges at cutouts are finished to match counter edge.
- .18 Fabricate all lower cabinets to be installed on square and level 102mm high plinth constructed of 19mm poplar plywood. Lower cabinet gables shall not extend to floor level.

## **2.8 FABRICATION – WASHROOM BENCH FABRICATION**

- .1 Fabricate washroom bench to NAAWS Custom Quality Grade, and as shown on Drawings.
- .2 Refer to washroom bench detail on Drawings, and construct bench as shown.
- .3 Metal components, fabrication and welding, to Section 05 50 00 - Metal Fabrications. Finish as per Section 09 91 00 – Painting, colour as determined by Consultant at a later date.
- .4 Provide all stainless steel carriage bolts and nuts, galvanized steel plate and angle bracket supports, HILTI HLC sleeve anchors, and blocking as required for a complete installation.
- .5 Red oak lumber to be cut to size and sanded smooth ready for finishing, with eased exposed edges. Finish as specified in this Section.

## **2.9 FABRICATION – PLASTIC LAMINATE**

- .1 NAAWS Quality Grade Custom.
- .2 Comply with NEMA LD 3, Annex 'A', and Manufacturer's Technical Data Sheets and fabrication guidelines.
- .3 Obtain governing dimensions before fabricating items that are to accommodate or abut appliances, equipment and other materials.
- .4 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .5 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 2400 mm. Keep joints 600 mm from sink cutouts.
- .6 Drill oversized holes for screws or bolts. Screws or bolts to be slightly countersunk into the face side of a laminate-clad substrate.
- .7 Provide cores of not less than 19 mm nominal thickness.
- .8 All inside corners to have a minimum of 1/8" (3.18 mm) radius, and all edges to be routed smooth.
- .9 Apply backing sheet to laminated flatwork. Supply uniform coating of sealer on exposed edges. Provide backing sheet of sufficient thickness to compensate stresses caused by facing sheet.

- .10 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.
- .11 Locate joints at 2400 mm to 3000 mm oc. At 'L' shaped corners mitre plastic laminate to outside corners. Accurately fit member together to provide tight and flush butt joints, in true planes. Provide 6 mm blind spline and approved type draw bolts. Provide 1 draw bolt for widths up to 150 mm. For width exceeding 150 mm, provide draw bolts at maximum 250 mm centres. Colour match adjoining units.
- .12 Provide cut outs as required for inserts, fixtures and fittings. Use radiused corners and chamfer edges around cut outs to avoid chipping laminate.
- .13 Doors: apply matching laminated plastic to both outside and inside faces of door panels.
- .14 At other locations, apply laminate backing sheet to reverse side of core of plastic laminate work.
- .15 Apply laminated plastic liner sheet to interior of cabinetry.
- .16 Post form laminate work to details indicated. Provide same core and laminate profiles to provide continuous support and bond for entire surface.
- .17 Assemble work, true and square. Arrange adjacent parts of continuous laminate work to match in colour and pattern.
- .18 Use hot-pressing method for adhering plastic laminate to substrate to greatest extent possible to minimize field application. Use only brush-applied adhesives suitable to the surfaces to be bonded.

## **2.10 FABRICATION – QUARTZ SURFACE**

- .1 Comply with Manufacturer's Technical Data Sheets and fabrication guidelines.
- .2 Fabricators to be certified by the manufacturer.
- .3 Factory fabricate components to sizes and shapes indicated, in accordance with approved shop drawings.
- .4 Provide factory cutouts for plumbing fittings and accessories as indicated on the drawings, and per approved shop drawings.
- .5 Cut and finish component edges and ends with clean, sharp returns. Fabricate square eased edge and contours to templates. Repair or reject and replace defective and inaccurate work.
- .6 Edge and exposed end treatment: square eased edge detail unless noted otherwise; comply with manufacturer's product data and as indicated on the reviewed shop drawings.
- .7 Substrates and Supports:
  - .1 Slabs for horizontal surfaces, such as countertops, to be supported not less than every 18" (45.7 cm), or as otherwise indicated on Shop Drawings.
- .8 Install work plumb, true and square, neatly scribed to adjoining surfaces, and in accordance with reviewed shop drawings and product data, laminated with adhesive to 19 mm thick exterior grade veneer core plywood.
- .9 Form field joints (if required and indicated on the reviewed shop drawings), using manufacturer's recommended procedures. Joints in finished work to be as inconspicuous as possible.

- .10 Adhere under-mount sinks/bowls to countertops using manufacturer's recommended adhesive and mounting hardware.
- .11 Adhere top-mount sinks/bowls to countertops using manufacturer's recommended adhesives and colour matched silicone sealants.
- .12 At junction of adjacent wall finish, apply small bead of silicone sealant.
- .13 Keep components clean during installation. Remove adhesives, sealants, and other stains. Buff out minor scratches to match adjacent undamaged surfaces. Replace defective Work at no expense to Owner.

## **2.11 FABRICATION – SOLID-SURFACING**

- .1 Comply with Manufacturer's Technical Data Sheets and fabrication guidelines.
- .2 Fabricators to be certified by the manufacturer.
- .3 Factory fabricate components to sizes and shapes indicated, in accordance with approved shop drawings.
- .4 Provide factory cutouts for plumbing fittings and accessories as indicated on the drawings, and per approved shop drawings.
- .5 Finish bowl or sink rims using manufacturer's recommendations. Repair or reject defective and inaccurate work.
- .6 Cut and finish component edges and ends with clean, sharp returns. Fabricate radii and contours to templates. Repair or reject and replace defective and inaccurate work.
- .7 Edge and exposed end treatment: straight edge detail unless noted otherwise; comply with manufacturer's product data and as indicated on the reviewed shop drawings.
- .8 Coved backsplashes: shop-fabricate 3/8" (9 mm) or other radius cove at intersection of counters and backsplashes.

## **2.12 SHOP FINISHING**

- .1 Finishes: refer to Drawings.
- .2 Hardwood Clear Finishing: to NAAWS Custom Quality Grade.
  - .1 Finishes shall be applied in accordance with Section 5 of the NAAWS.
  - .2 Clear Finish (NAAWS Finish System 2):
    - .1 Exposed hardwood requiring clear finish shall have 4 coats of NAAWS pre-catalyzed lacquer, satin gloss, premium grade lacquer coating.
    - .2 Semi-Exposed parts requiring clear finish shall have NAAWS pre-catalyzed lacquer finish to match exposed components, including all surfaces of reveals and returns, underside of items and inside. Semi-exposed parts shall match exposed parts for finishing.
- .3 Shop-fabricate and finish to greatest extent possible.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Site Conditions for installation of architectural woodwork shall be in accordance with applicable NAAWS requirements.



- .2 Verify condition and dimensions of previously installed work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

### **3.2 COORDINATION**

- .1 Coordinate with other trades as required for a complete installation and as required to maintain project schedule.
- .2 Coordinate and cooperate with plumbing and electrical trades as required for complete installations (e.g., sinks and faucets, lighting, electrical wiring and outlets, and communications and security installations) and as required to maintain project schedule.

### **3.3 PREPARATION**

- .1 Obtain measurements from site.
- .2 Check access to ensure large pieces of work can be safely handled to their place of final installation.
- .3 Verify that solid blocking for support and anchoring of woodwork is installed where required. Confirm exact height and location with Drawings and Consultant.
- .4 Protect finished surfaces and materials of other trades from damage.
- .5 Ensure services and roughing-in which affect or are connected to or through this work are complete and acceptable.
- .6 Back prime cabinet work immediately after delivery to site.

### **3.4 ISOLATION COATING**

- .1 Apply isolation coating to metal surfaces in contact with cementitious materials, preservative-treated or fire-retardant treated wood materials, and dissimilar metals.
- .2 Apply isolation coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Each application needs enough product applied so that excess isolation coating “oozes out” during assembly (this will ensure you have created a proper seal).
- .4 Assemble and wipe away any excess product.

### **3.5 INSTALLATION**

- .1 Coordinate and cooperate with other trades as required.
- .2 Install architectural woodwork and millwork to NAAWS Custom Quality Grade, and as shown on Drawings.
- .3 Install washroom bench as indicated, secure, level, square and true.
- .4 Install prefinished millwork at locations shown on drawings. Install work plumb, true and square, neatly scribed to adjoining surfaces.
- .5 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.
- .6 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.

- .7 Fasten and anchor millwork securely.
  - .1 Anchor to floor, walls, or ceiling using heavy duty fastening devices and hardware consistent with the building materials encountered. Do not use wood plugs. Do not use plastic plugs for ceilings or walls. Provide wall strapping as required.
- .8 Use draw bolts and splines in countertop joints. Maximum spacing 450 mm on centre, 75 mm from edge. Make flush hairline joints.
- .9 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.
- .10 At junctions of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07 92 00 - Joint Sealants. Apply joint sealants at other locations as indicated.
- .11 Shop-apply laminated plastic to units as indicated.
  - .1 Adhere laminated plastic over entire surface.
  - .2 Make corners with hairline joints.
  - .3 Use full sized laminate sheets.
  - .4 Make joints only where approved by Consultant.
  - .5 Slightly bevel arises.
- .12 For site application, offset joints in plastic laminate facing from joints in core.
- .13 Alternative Price Item: if added to Contract by Owner, install stainless steel counter with integral sinks and integrate into casework base unit as required. Coordinate and cooperate with other trades as required for installation of fitments (e.g., faucets and soap dispensers) and connections to services.
- .14 Plastic Laminate:
  - .1 Manufacturer's Instructions:
    - .1 Comply with manufacturer's data sheets, published installation requirements, standard details, and specifications.
  - .2 Install work plumb, true and square, neatly scribed to adjoining surfaces.
  - .3 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.
  - .4 Use draw bolts and splines in countertop joints. Maximum spacing 450 mm on centre, 75 mm from edge. Make flush hairline joints.
  - .5 Provide cut-outs for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.
  - .6 At junction of laminated plastic counter back splash and adjacent wall finish, apply small bead of sealant.
  - .7 Protection:
    - .8 Cover finished laminated plastic veneered surfaces with heavy Kraft paper or put in cartons during shipment. Protect installed laminated surfaces by approved means. Do not remove until immediately before final inspection.
  - .9 Cleaning:
    - .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
    - .2 Perform care and cleaning with NEMA LD3, Annex B.
    - .3 Remove traces of primer, caulking, epoxy and filler materials; clean doors and frames.
- .15 Solid Surfacing:
  - .1 Install per manufacturer's published technical briefs, guidelines, and specifications. Installers to be certified by the manufacturer.
  - .2 Substrates and Supports:

- .1 Slabs for horizontal surfaces, such as countertops, to be supported not less than every 18" (45.7 cm), or as recommended by the solid surfacing manufacturer.
- .3 Install work plumb, true and square, neatly scribed to adjoining surfaces, and in accordance with reviewed shop drawings and product data.
- .4 Form field joints (if required and indicated on the reviewed shop drawings), using manufacturer's recommended procedures. Joints in finished work to be as inconspicuous as possible.
- .5 Adhere under-mount sinks/bowls to countertops using manufacturer's recommended adhesive and mounting hardware.
- .6 Adhere top-mount sinks/bowls to countertops using manufacturer's recommended adhesives and colour matched silicone sealants.
- .7 Provide backsplashes and side splashes where indicated on the drawings. Backsplash and front edge treatment to be integral with countertop.
- .8 At junction of backsplash, and adjacent wall finish, apply small bead of silicone sealant.
- .9 Keep components clean during installation. Remove adhesives, sealants, and other stains. Buff out minor scratches to match adjacent undamaged surfaces. Replace defective Work at no expense to Owner.
- .16 Quartz Surface:
  - .1 Seal stone materials before shipping to site.
  - .2 Install per manufacturer's published technical briefs, guidelines, and specifications. Installers to be certified by the manufacturer.
  - .3 Substrates and Supports:
    - .1 Slabs for horizontal surfaces, such as countertops, to be supported not less than every 18" (45.7 cm), or as recommended by the quartz surface manufacturer.
  - .4 Install work plumb, true and square, neatly scribed to adjoining surfaces, and in accordance with reviewed shop drawings and product data.
  - .5 Form field joints (if required and indicated on the reviewed shop drawings), using manufacturer's recommended procedures. Joints in finished work to be as inconspicuous as possible.
  - .6 Adhere under-mount sinks/bowls to countertops using manufacturer's recommended adhesive and mounting hardware.
  - .7 Adhere top-mount sinks/bowls to countertops using manufacturer's recommended adhesives and colour matched silicone sealants.
  - .8 Provide backsplashes and side splashes where indicated on the drawings. Backsplash and front edge treatment to be integral with countertop.
  - .9 At junction of backsplash, and adjacent wall finish, apply small bead of silicone sealant.
  - .10 Keep components clean during installation. Remove adhesives, sealants, and other stains. Buff out minor scratches to match adjacent undamaged surfaces. Replace defective Work at no expense to Owner.

- .17 Supply and install hardware required for the completion of architectural woodwork, including, without limitations, adjustable shelf supports and cabinet hinges, catches, pulls, drawer accessories, bumpers, drawer slides and closet hanger bars, and similar items. Install millwork hardware in the shop wherever possible. Install millwork hardware secure, plumb, level, true to line, and in accordance with the hardware manufacturer's published instructions. Cut and fit to millwork for proper installation and operation. Provide smoothly operating units free from binding. Clean and adjust hardware for proper operation.
- .18 Where access is required to valves and other mechanical and electrical components located within cabinetwork, install removable plywood access panels of size required to permit safe and easy access, and secure with 4 screws.

### **3.6 ADJUSTING**

- .1 During and after installation adjust all hardware and operating parts as necessary to ensure smooth and proper operation.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.9 SCHEDULE**

- .1 Fabricate and install as specified and in accordance with the Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 cast-in-place concrete.
- .2 Section 04 22 00 – Unit Masonry.
- .3 Section 05 41 00 – Structural Metal Stud Framing.
- .4 Section 07 26 13 – Polyethylene Vapour Control System.
- .5 Section 07 21 16 – Fibrous Insulation.
- .6 Section 07 42 42 – Aluminum Composite Panels
- .7 Section 07 46 19 – Preformed Metal Cladding
- .8 Section 07 92 00 – Joint Sealants.
- .9 Section 13 34 19 – Pre-engineered Metal Building RFQ.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A792/A792M-23, Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .2 ASTM C177-19e1, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
  - .3 ASTM C203-22, Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
  - .4 ASTM C518-21, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .5 ASTM D1621-16(2023), Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
  - .6 ASTM D2842-25, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
  - .7 ASTM D3575-20, Standard Test Methods for Flexible Cellular Materials Made from Olefin Polymers.
  - .8 ASTM E84-24, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .9 ASTM E96/E96M-24a, Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
  - .10 ASTM E2178-21a, Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.
- .2 ULC Standards
  - .1 ULC S102-2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 ULC S114-2018, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .3 CAN/ULC S701.1-22, Standard for Thermal Insulation, Polystyrene Boards.
  - .4 ULC S710.1-2019, Standard for Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Material Specification.

- .5 ULC S710.2-2011, Standard for Thermal Insulation - Bead-Applied One Component Polyurethane Air Sealant Foam - Part 2: Installation.
- .6 CAN/ULC S770-15, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Consultant in accordance with Division 1 requirements to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions.

### **1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Division 01 requirements:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet.
- .2 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.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Storage and Handling Requirements:
  - .1 Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
  - .2 Protect plastic insulation as follows:
    - .1 Do not expose to sunlight, except to extent necessary for period of installation and concealment.
    - .2 Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
    - .3 Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### **1.7 WARRANTIES**

- .1 Submit manufacturer's standard limited warranty for each product incorporated into the Work.

**Part 2 Products**

**2.1 CONTINUOUS EXTERIOR RIGID BOARD INSULATION**

- .1 Extruded closed-cell polystyrene (XPS), to CAN/ULC-S701.1, with the following minimum physical properties:
  - .1 Type: 4.
  - .2 Edges: square.
  - .3 Size: 1220 mm x 2438 mm.
  - .4 Thickness: 51 mm.
  - .5 LTTR, to CAN/ULC S770: RSI 1.67 at 50.8 mm thickness.
  - .6 Compressive strength: 140 kPa (20 psi), tested to ASTM D1621.
  - .7 Compressive modulus, to ASTM D1621: 6895 kPa (1000 psi).
  - .8 Flexural strength, to ASTM C203: 414 kPa (60 psi).
  - .9 Water vapour permeance: 37 ng/Pa·s·m<sup>2</sup> (0.65 Perms) tested to ASTM E96.
  - .10 Water absorption: ≤ 0.40, tested to ASTM D2842.
  - .11 Non-combustible, to CAN/ULC S114.
  - .12 Standard of Acceptance:
    - .1 Owens Corning® FOAMULAR® NGX® C-200 Extruded Polystyrene (XPS) Rigid Foam Insulation.

**2.2 REGULAR FOUNDATION AND UNDERSLAB INSULATION**

- .1 Locations: as indicated at foundation walls W-F1, W-F2, W-F3 and Floor Type F-1 and.
- .2 Regular Foundation and Underslab Insulation: Extruded polystyrene (XPS) to CAN/ULC S701.1 and as follows:
  - .1 Type: IV.
  - .2 Thermal Resistance: LTTR RSI 0.87/25 mm minimum.
  - .3 Edges: square.
  - .4 Size: 610 mm x 2440 mm x thickness as indicated on Drawings.
  - .5 Compressive Strength: minimum 200 kPa at 10% deformation in accordance with ASTM D1621.
  - .6 Water Absorption: maximum 0.7% (% by volume) in conformance with ASTM D2842.
  - .7 Acceptable Materials:
    - .1 Styrofoam SM, DuPont™ Canada.
    - .2 Foamular C-300, Owens-Corning Canada LP.
    - .3 Sopra-XPS 30, Soprema.

**2.3 HIGH COMPRESSIVE STRENGTH UNDERSLAB INSULATION**

- .1 Locations: Floor Type F-2.
- .2 Compressive strength: 415 kPa (60 psi).
- .3 Load Bearing Insulation: Extruded Polystyrene (XPS) high-density extruded type in accordance with CAN/ULC S701.1 and CAN/ULC S770 and as follows:
  - .1 Type: 4
  - .2 Thermal Resistance: LTTR RSI 0.87/25 mm minimum.

- .3 Edges: square.
- .4 Size: 1220 mm x 2440 mm x thickness as indicated on Drawings.
- .5 Compressive Strength: minimum 410 kPa at 5% deformation in accordance with ASTM D1621.
- .6 Water Absorption: maximum 1% (% by volume) in conformance with ASTM D2842.
- .7 Acceptable Materials:
  - .1 DuPont™ Styrofoam™ Brand Highload 60 Extruded Polystyrene Insulation, DuPont™ Canada.
  - .2 Owens Corning® FOAMULAR® NGX® 600.
  - .3 Soprema Sopra-XPS 60.

## 2.4 ROOF INSULATION

- .1 Roof Type R01: to Section 07 21 16 - Fibrous Insulation.

## 2.5 ACCESSORIES

- .1 Sill Gaskets: Polyethylene, flexible, durable and moisture resistant.
  - .1 Locations: as required to seal between sill plate and foundation.
  - .2 Manufacturer: ProPINK ComfortSeal™ manufactured by Owens Corning Canada.
  - .3 Density: 16-19 kg/m<sup>3</sup> tested to ASTM D3575.
  - .4 Tear Resistance: 8.2 kg/m<sup>3</sup> tested to ASTM D3575.
  - .5 Dimensions: Rolls, 3.2 mm thick x width as required to suit field conditions.
- .2 Joint and Flashing tape: Acrylic polyolefin, self-adhesive type with aggressive acrylic adhesive and release liner backing.
  - .1 Locations: as required to seal joints between polystyrene boards and between air barrier system and adjacent building materials such as windows, doors and other openings.
  - .2 Manufacturer: JointSealR® joint tape manufactured by Owens Corning Canada.
  - .3 Dimensions: Rolls, 0.25 mm thick x 89 mm width x 27.4 m length.
  - .4 Air permeability at 75 Pa: 0.00017 L/s.m<sup>2</sup> tested to ASTM E2178.
  - .5 Water vapour permeance: 11 ng / Pa·m<sup>2</sup>·s, tested to ASTM E2178.
  - .6 Flame spread/smoke developed: 5/25 tested to ASTM E84.
- .3 Foam Sealant: Low-expansion polyurethane, to ULC S710.1 and ULC 710.2.
  - .1 Locations: as required to seal joints between polystyrene boards and between air barrier system and adjacent building materials such as windows, doors and other openings where flashing tape is not the best choice based on field conditions at affected locations.
  - .2 Air permeability: ≤ 0.05 L/s.m<sup>2</sup> at 75 Pa
  - .3 Initial thermal resistance: RSI 0.8 / 25 mm.
- .4 Fibreglass batt insulation, to Section 07 21 16 - Fibrous Insulation.
- .5 Silicone building sealant: to Section 07 92 00 - Joint Sealants.
  - .1 Locations: to seal fastener heads at fastener penetrations of insulation to ensure continuity of air/weather barrier/moisture drainage plane performance.



- .6 Insulation adhesives:
  - .1 Locations: applied as a continuous ribbon bead at z-girt bonding surfaces to adhere insulation boards to z-girts.
  - .2 Acceptable Materials:
    - .1 Loctite PL 300 Foamboard Adhesive, or equivalent.
    - .2 230-21 or Airbloc 21 Rigid Insulation Adhesive, by Henry Company, or equivalent.
- .7 Insulation Fasteners:
  - .1 Locations: to hold board insulation tight to Z-girt bonding surfaces while insulation adhesive sets and cures.
  - .2 Self-Drilling Screws:
    - .1 Large Flange Hex Self-Drill Point #2 Screws - #10-16 x Length required, complete with integral neoprene or EPDM washer system. Hot dipped galvanized after fabrication.
    - .2 Do not remove screws once they have penetrated insulation.
- .8 Protection Board: Pre-moulded, semi-rigid asphalt/fibre composition board, minimum 6 mm thick, formed under heat and pressure as recommended by board insulation manufacturer for below grade installations.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verify that surfaces and conditions are ready to accept the Work of this section.
- .2 Ensure all surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
- .3 Do not start work until deficiencies have been corrected. Commencement of Work implies acceptance of conditions.
- .4 Proceeding with work means acceptance of conditions.

#### **3.2 PREPARATION**

- .1 Prior to commencement of work ensure:
  - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.
  - .2 Remove loose or foreign matter which might impair adhesion of materials.
  - .3 Ensure all substrates are free of surface moisture prior to application of air barrier system.

#### **3.3 EXTERIOR WALL ASSEMBLY AND INTERIOR CEILING INSULATION**

- .1 Install products of this Section to manufacturer's published instructions, and as indicated on Drawings at wall assemblies, and at ceiling over vestibule.
- .2 Sill gaskets: Prior to wall installation, install sill gasket between bottom sill plates and foundation, and on vertical face of sill plate. Use two layers of gasket if necessary to achieve a proper seal.
- .3 Gaskets: Install gaskets between all insulation board joints and framing, and at all corners where one exterior wall abuts another exterior wall.

- .4 Polystyrene boards:
  - .1 Use only insulation boards free from chipped or broken edges.
  - .2 Apply insulation adhesive to Z-girts bonding surfaces to which the insulation boards will be affixed; apply adhesive in accordance with adhesive manufacturer's published application instructions.
  - .3 Mechanically hold insulation in place using self-drilled screws with integral neoprene or EPDM washers. Do not remove fasteners once they have penetrated the insulation. Use the minimum necessary to hold insulation in place while the adhesive sets, and at locations where it is necessary to ensure a snug fit between materials. Apply 100% silicone construction sealant over screw heads as an extra measure to ensure a tight seal.
  - .4 Install polystyrene boards with offset joints; butt joints tightly and ensure a plumb, level and square installation, as weathertight as possible.
  - .5 Cut and fit insulation tight around electrical boxes, conduits, doors and windows and all other penetrations in exterior building envelope.
  - .6 Keep insulation minimum 75 mm from heat-emitting devices such as chimneys and vents protruding through wall.
- .5 Seal all external corner board joints with joint tape.
- .6 Seal all penetrations using joint and flashing tape to maintain a continuous air barrier, including those made by work of other Sections and by exterior cladding fastening devices.
- .7 Seal voids around windows, doors, ventilation louvres and other elements located in the air barrier system plane with polyurethane foam sealant. Avoid spillage past voids and protect from contact with water.
- .8 Install blanket installation in stud wall spaces as indicated with tight joints, and around service equipment such as electrical boxes, pipes and ducts. Keep minimum 75 mm from heat-emitting devices such as lights or chimneys.

### **3.4 UNDERSLAB AND BELOW-GRADE HORIZONTAL INSULATION**

- .1 Install insulations under slabs-on-ground, ground beams, and as shown on Drawings.
- .2 Ensure granular base has been compacted to minimum 98% SPD, and is level, flat and ready to receive insulation.
- .3 Install boards as indicated on Drawings, and as follows:
  - .1 Lay boards on level compacted fill.
  - .2 Protect top surface of horizontal insulation from damage during concrete work by applying protection board.
- .4 Floor Type F-1: install Regular Foundation and Underslab Insulation as shown on Drawings.
- .5 Floor Type F-2: Load Bearing Insulation: Install in accordance with manufacturer's published instructions, and as follows:
  - .1 Load Bearing Insulation: Install board insulation horizontally having a minimum compressive strength as specified in this Section on level, compacted fill to locations indicated on Drawings.
- .6 Tape joints of underslab insulation, and fill any gaps in the insulation with spray foam insulation, to ULC S710.2. Ensure perimeter is sealed to the foundations.

### **3.5 FOUNDATION INSULATION**

- .1 Locations: W-F1, W-F2, W-F3, around piers, and other below-grade surfaces and locations as shown on Drawings.
- .2 Install foundation insulation at foundations as indicated on Drawings. Adhere in place and use mechanical fasteners as required to hold insulation tight against foundation while the adhesive sets and cures. Leave fasteners in place and seal heads with waterproofing mastic compatible with insulation material.
- .3 Apply adhesive to the substrate by the "dab" method not less than 10 mm x 20 mm size at 150 mm centres; bed the insulation in the adhesive before the adhesive loses its tack or skins over.
- .4 Protect below grade insulation on vertical surfaces from damage during backfilling by applying protection board; set in adhesive according to insulation manufacturer's written instructions.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.8 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 09 21 16 - Gypsum Board Assemblies.
- .2    Section 09 22 00 - Non-Structural Metal Framing.
- .3    Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2            REFERENCES**

- .1    ASTM International (ASTM)
  - .1    ASTM C167-25, Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
  - .2    ASTM C423-23e1, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .3    ASTM C553-24, Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .4    ASTM C665-24, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - .5    ASTM C954-22, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
  - .6    ASTM C1002-22, Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .7    ASTM C1320-20, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
  - .8    ASTM E90-23, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .9    ASTM E413-22, Classification for Rating Sound Insulation.
- .2    Canadian Gas Association (CGA)
  - .1    CAN/CSA B149.1:25, Natural Gas and Propane Installation Code.
  - .2    CAN/CGA B149.2:25, Propane Storage and Handling Code.
- .3    ULC Standards (ULC)
  - .1    ULC S102:2018, Standard Method of Test For Surface Burning Characteristics of Building Materials and Assemblies.
  - .2    ULC S114:2018, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .3    ULC S604:2022, Standard for Factory Built Type A Chimneys.
  - .4    ULC S702.1:2021, Standard for Thermal Insulation Mineral Fibre for Buildings, Part 1: Material Specification.
  - .5    CAN/ULC S702.2:2015, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 2: Installation

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit product data in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
  - .1 Submit manufacturer's published product literature, specifications and datasheets for all products and materials incorporated into the Work of Contract.
- .2 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.
- .3 Submit close-out documents in accordance with Section 01 78 00.

### **1.4 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.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver insulation and accessories in original unopened packaging or cartons bearing manufacturer's seals and labels.
- .2 Store materials under cover on raised platforms, away from moisture. Keep dry at all times.

## **Part 2 Products**

### **2.1 SEMI-RIGID ROOF INSULATION – BASE BID**

- .1 Locations: where semi-rigid insulation is indicated on Drawings, and at Roof Type R-1 between the roof purlins.
- .2 CAN/ULC S702 Type 1.
- .3 Density, to ASTM C303: 38 kg/m<sup>3</sup>.
- .4 Steel corrosion testing, to ASTM C795 and ASTM C665: passes.
- .5 Thermal Performance of Insulation: RSI 0.7/25.4 mm; R-4./inch.
- .6 Standard of Acceptance:
  - .1 ROCKWOOL Plus™ MB, by Rockwool, or equivalent.

### **2.2 BLANKET ROLL ROOF INSULATION – BASE BID**

- .1 Locations: blanket roll insulation to be installed over the roof purlins and the between-the-purlin semi-rigid insulation; install at metal Roof Type R-1.
- .2 Mineral wool insulation ULC 702.1 Type 1.
- .3 Thermal conductivity lambda ( $\lambda$ ) value of 0.044 W/mK, in accordance with BS EN 13162:2012 + A1:2015, at 150 mm thickness; R-value: approx. R-3.41/6 inches.
- .4 Standard of Acceptance:
  - .1 Blanket Roll Insulation, by Rockwool, or equivalent mineral wool insulation in blanket roll format.

## **2.3 WALL AND CEILING BATT INSULATION – BASE BID**

- .1 Fibrous Glass Acoustical Insulation: un-faced, preformed GreenGuard™ or formaldehyde free binder fibreglass batt insulation meeting the requirements of ASTM C423, ASTM E90, ASTM E413 and ULC 702.1, and as follows:
  - .1 Locations: install where indicated on Drawings at Wall Types W-EX1, W-EX2, W-P2a and W-P2b, and at interior ceilings and wall locations as indicated.
  - .2 ULC 702.1 Type 1.
  - .2 Width: as required to suit site conditions at location of installation.
  - .1 Thickness: as required to 100% fill insulated spaces.
  - .2 Acceptable Materials:
    - .1 Lanaé Sustainable Insulation™, CertainTeed Insulation Canada Inc.
    - .2 Performance+ EcoBatt, with ECOSE® Technology, by Knauf Insulation.
    - .3 Sound-SHIELD® Formaldehyde-Free™ Fibreglass Insulation Unfaced, by Johns Manville.
    - .4 Quietzone® Pink Next Gen® Fiberglas®, by Owen-Corning Canada Inc.

## **2.4 EXTERIOR WALL BATT INSULATION – ALTERNATIVE**

- .1 Mineral wool batt insulation for application at exterior shell as required to maintain continuity of thermal performance, and as indicated on Drawings.
  - .2 Locations: Wall Types W-EX1, W-EX2.
  - .3 ULC 702.1 Type 1.
  - .4 Width: to friction fit in stud spaces.
  - .5 Thickness: as required to 100% fill insulated spaces.
  - .6 Acceptable Materials:
    - .1 Rockwool ComfortBatt®.
    - .2 JM Mineral Wool Sound Attenuation Fire Batts (SAFB), by Johns Manville.
    - .3 Thermafiber® UltraBatt™ Mineral Wool Thermal Batt Insulation, by Thermafiber, Inc.

## **2.5 INTERIOR WALL AND CEILING BATT INSULATION – ALTERNATIVE**

- .1 Mineral wool batt insulation: unfaced preformed GreenGuard™ certified formaldehyde-free fibrous insulation meeting the requirements of ULC S702, and as follows:
  - .1 Locations: Wall types W-P2a and W-P2b, and at interior ceilings and wall locations as indicated.
  - .2 ULC 702.1 Type 1.
  - .3 Width: as required to suit site conditions at location of installation.
  - .4 Thickness: as required to 100% fill insulated spaces.
  - .5 Acceptable Materials:
    - .1 JM Mineral Wool Sound Attenuation Fire Batts (SAFB), by Johns Manville.
    - .2 Rockwool ComfortBatt® SS, by Rockwool International A/S.
    - .3 Thermafiber® UltraBatt™ Mineral Wool Thermal Batt Insulation, by Thermafiber, Inc.

## **2.6 ACCESSORIES**

- .1 Insulation netting: as recommended by manufacturer to hold insulation in place at overhead locations and other locations where insulation needs to be held in place until other construction is installed.
- .2 Provide all accessories as required for a complete installation, and as per insulation manufacturer's published installation guidelines and specifications.
- .3 Fasteners: to ASTM C1002 or ASTM C954 as applicable, dimensions as required to suit purpose and conditions.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's published installation instructions, datasheets, standard details, and specifications.

### **3.2 EXAMINATION**

- .1 Examine substrates and immediately inform Consultant in writing of defects.
- .2 Prior to commencement of work, ensure:
  - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

### **3.3 INSTALLATION**

- .1 Install fibrous insulation in accordance with manufacturer's published installation instructions at locations as shown on Drawings.
- .2 Install insulation between framing members, structural components and other items, snug and tight. Where required, hold insulation in place with insulation netting.
- .3 Semi-rigid roof insulation at Roof Type R-1:
  - .1 Install in two layers of equal thickness as required to completely fill cavity between purlins. Offset joints by 100 mm.
- .4 Blanket roll roof insulation at Roof Type R-1:
  - .1 Install in two layers, 76 mm thick each layer, with 100 mm offset joints, and as required to completely cover the roof purlins and 100% of the roof area under the metal roof cladding. Do not position joints over purlins.
- .5 Cut and trim insulation neatly to fit spaces. Use insulation free from ripped or damaged back and edges.
- .6 Do not excessively compress insulation to fit into spaces.
- .7 Fit insulation closely around electrical boxes, wires, pipes, ducts, frames, and other objects in or passing through insulation.
- .8 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 Type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B and L vents.
- .9 Hold insulation in position with screws, clips, or wires, or as recommended by manufacturer when insulation is installed in horizontal locations.
- .10 Do not enclose insulation until it has been reviewed by Consultant.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.6 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**



**Part 1            General**

**1.1            SECTION INCLUDES**

- .1      This section includes requirements for supply and installation of a spray polyurethane foam air and vapour seal system, and other components to bridge and seal the following air leakage pathways and gaps between; but not limited to, the following
  - .1          Connections of the walls to the roof air seal.
  - .2          Connections of the walls to the foundations.
  - .3          Expansion joints.
  - .4          Openings and penetrations.
  - .5          Piping, conduit, duct and similar penetrations.
  - .6          All other air leakage pathways in the building envelope.
  - .7          A spray applied thermal barrier over the polyurethane.
  - .8          As indicated on the design Drawings.

**1.2            REFERENCES**

- .1      ASTM International (ASTM)
  - .1          ASTM C411-19, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .2          ASTM C518-21, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .3          ASTM C1338-25, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .4          ASTM D1621-16(2023), Standard Test Method for Compressive Properties Of Rigid Cellular Plastics.
  - .5          ASTM D1622-20, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
  - .6          ASTM D1623-17(2023), Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
  - .7          ASTM D2126-25, Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
  - .8          ASTM D2369-24, Standard Test Method for Volatile Content of Coatings.
  - .9          ASTM D2842-25, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
  - .10        ASTM D6226-21, Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
  - .11        ASTM E96/E96M-24a, Standard Test Methods for Water Vapor Transmission of Materials.
- .2      Underwriters' Laboratories of Canada (ULC)
  - .1          CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2          ULC S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies, 06/01/2018.
  - .3          CAN/ULC S127-14, Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Building Materials.
  - .4          ULC S705.1, Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material Specification, 12/18/2018.

- .5 ULC 705.2, Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Application, 07/08/2020.
- .6 ULC 718, Standard for Site Quality Assurance Program for Spray Polyurethane Foam, 2018.
- .7 CAN/ULC S770-15, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.
- .8 CAN/ULC S774, Standard Laboratory Guide for the Determination of Volatile Organic Compound Emissions from Polyurethane Foam, 03/17/2020.

### **1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit manufacturer's published product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Test reports: submit certified test reports for insulation from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
  - .2 Submit test reports in accordance with ULC 101 for fire endurance and ULC 102 for surface burning characteristics.
  - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
- .3 Moisture content of wood: measure moisture content of wood that is to be in direct contact with insulation. Submit results to Consultant for review. Measure ten different locations and report on plans and details.

### **1.4 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: person specializing in sprayed insulation installations with five (5) years documented experience, and approved by manufacturer.
  - .2 Manufacturer: company with minimum five years experience in producing of material used for work required for this project, with sufficient production capacity to produce and deliver required units without causing delay in work.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials in sealed unopened containers clearly indicating manufacturer, product identification and safety information.
- .4 Store materials above minimum temperature as recommended by manufacturer.
- .5 Store materials in dry and well-ventilated area away from weather and direct sunlight. Maintain temperatures between 18°C and 30°C.
- .6 Packaging Waste Management

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## **1.6 SITE CONDITIONS**

- .1 Ventilate area in accordance with Section 01 51 00 - Temporary Utilities.
- .2 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
- .3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.
- .4 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
- .5 Apply insulation only when surfaces and ambient temperatures are within manufacturer's prescribed limits.
- .6 Use of insulation products manufactured with HFCs, HCFCs or CFCs as blowing agents is prohibited.
- .7 Sequence, plan and coordinate the insulation Work to minimize the generation of cut-offs and waste.

## **1.7 WARRANTY**

- .1 Provide manufacturer's standard limited warranty.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Single source responsibility: Obtain Products 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 the same production run including all extra stock materials.
- .2 Aged thermal performance, to ASTM C518: R-6.7 per inch.
- .3 Standard of Acceptance:
  - .1 PERMAX 3.0 HFO Closed Cell Foam Insulation, by Henry Company, or equivalent with same or better aged thermal performance, and meeting OBC requirements.
- .4 Primers: in accordance with manufacturer's recommendations for surface conditions.
- .5 Thermal Barrier: spray applied fire retardant overcoat meeting applicable requirements of the Current Building Code for thermal barrier of foamed plastic.
  - .1 Acceptable Materials:
    - .1 A/D Thermal Barrier, AD Fire Protection Systems.
    - .2 Monokote Z-3306, WR Grace & Co.
    - .3 Other material approved by the spray foam manufacturer, compatible with their product, and meeting Code requirements.

### **2.2 EQUIPMENT**

- .1 Comply with CAN/ULC S705.2 and the equipment manufacturer's recommendations for application type.

## **2.3 ACCESSORIES**

- .1 Prime substrate when required by spray polyurethane manufacturer or the membrane manufacturer. Follow requirements of the manufacturer for the type of primer and the installation of the primer for the surface conditions.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Inspect areas to receive work of this Section and ensure conditions are suitable to begin application.
- .2 Verify that work penetrating through air seal is complete.
- .3 Verify that appropriate back-up material has been installed in all large voids.

### **3.2 PREPARATION**

- .1 Protect finish surfaces which may be exposed to view from overspray.
- .2 Clean substrates of dirt, dust, grease, oil, loose material and other matter which may affect bond of spray applied materials.
- .3 Remove oil from galvanized sheet steel substrates and apply prime coating in accordance with manufacturer's instructions.

### **3.3 APPLICATION**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Apply insulation to clean surfaces in accordance with ULC-S705.2, ULC S718, and manufacturer's published instructions.
- .3 Use primer as recommended by manufacturer.
- .4 Apply sprayed foam insulation in thickness as indicated.
- .5 Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened.
- .6 Repair damaged areas in accordance with manufacturer's application guidelines for insulation.
- .7 Cover spray polyurethane foam with fire retardant overcoat when installed on building interior and above exterior soffits in accordance with manufacturer's instructions.

### **3.4 THERMAL BARRIER**

- .1 Surfaces to receive cementitious thermal barrier must be free of dirt, oil, grease or other substances which may impair adhesion to the foamed plastic. Adhesive may be required for high humidity environments and on horizontal surfaces.
- .2 Thermal barrier shall be applied only by authorized applicators.
- .3 Mix as per manufacturers published instructions to form a slurry.
- .4 Spray-apply slurry using a fireproofing/plaster pump.

**3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.7 SCHEDULE**

- .1 Prime surfaces and spray-apply foam insulation, complete with thermal barrier, where spray-applied foam insulation is indicated. or otherwise required to maintain continuity of enclosure thermal control systems and performance.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 21 29 - Spray Applied Polyurethane Foam.
- .2 Section 07 92 00 - Joint Sealants.
- .3 Section 09 21 16 - Gypsum Board Assemblies.
- .4 Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D4397-16(2023), Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

**1.3 DEFINITIONS**

- .1 Air Barrier: Systems of materials designed and constructed to control airflow between conditioned and unconditioned spaces.
- .2 Air / Vapour Barrier: Systems of materials exhibiting both low air leakage (airtight) and low Vapour Permeance (vapour impermeable) levels, and functioning as a combined Air Barrier and Vapour Retarder.
- .3 Enclosure: Boundary or barrier separating the interior of a building from the exterior environment and conditions.
- .4 Vapour Permeance: The moisture transmission rate of a material is referred to as its 'permeability'. This number is not dependent on the material's thickness. Its 'permeance', however, is dependent on thickness much like the R-value in heat transmission. Dividing the 'permeability' of a material by its thickness gives the material's 'permeance'.
- .5 Vapour Permeance Classes:
  - .1 Vapour impermeable:  $5.72 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$  or less.
  - .2 Vapour semi-impermeable:  $57.21 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$  or less, and greater than  $5.72 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$ .
  - .3 Vapour semi-permeable:  $572.14 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$  or less, and greater than  $57.21 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$ .
  - .4 Vapour permeable: Greater than  $572.14 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$ .
- .6 Vapour Retarder (vapour diffusion retarder): Element that is designed and installed in an assembly to retard the movement of water by vapour diffusion.

**1.4 DESIGN INTENT**

- .1 The air barrier at the exterior walls is to be achieved by the exterior insulation boards, with joints taped and all penetrations sealed.
- .2 The interior metal liner panels at walls and roof, caulked and sealed, and the polyethylene sheet vapour retarder, form the vapour control systems.
- .3 The metal liner panels shall be fully caulked and sealed as necessary to achieve continuity of performance.

## **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination:
  - .1 Select products to be compatible with adjoining work previously installed.
  - .2 Select products from a single manufacturer, or products that are compatible from different manufacturers.
  - .3 Coordination between all installers of each component of vapour and air control systems is essential to ensure continuity of systems and that transitions between the various components are effectively sealed.
  - .4 Coordinate and cooperate with related trades involved with installation procedures of building products forming the air and vapour control systems, including, but not limited to, liner sheets, polyethylene vapour retarder, and various sealants.
- .2 Sequencing:
  - .1 Sequence work in accordance with construction schedule.
  - .2 Sequence work to permit installation of materials in conjunction with related materials and seals.
  - .3 Overlap and terminate materials as required to ensure continuity of performance.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's published product literature and datasheets for products incorporated into the Work of Contract.

## **1.7 QUALITY ASSURANCE**

- .1 Installer shall be experienced at work that includes the installation of air and vapour control systems, managing transitions between building elements, and maintaining continuity of performance, with a minimum 5-year documented history of successful work of this type.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Division 01 requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

## **1.9 AMBIENT CONDITIONS**

- .1 Install solvent-curing sealants and vapour release adhesive materials in open spaces with ventilation.
- .2 Ventilate enclosed spaces in accordance with Division 01 requirements.
- .3 Maintain temperature and humidity recommended by materials manufacturer before, during and after installation.

## **1.10 WARRANTIES**

- .1 Contractor agrees to correct any deficiencies of labour or material found in the work performed for a period of 2 years from date of Substantial Performance.

**Part 2 Products**

**2.1 POLYETHYLENE VAPOUR BARRIER – INTERIOR APPLICATIONS**

- .1 Clear Polyethylene Vapour Barrier: meeting or exceeding the requirements of ASTM D4397, and having a minimum thickness of 6 mils as verified by third-party testing.
- .2 Accessories:
  - .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 2" wide for lap joints and perimeter seals, 1" wide elsewhere.
    - .1 Acceptable materials:
      - .1 Tuck Tape Blue Sheathing Tape for PE Vapour Barrier.
      - .2 Canvex® Seal Tape (TS4WT), by Global Plastic Sheeting.
- .3 Sealants: compatible with vapour retarder materials, recommended by vapour retarder manufacturer, to Section 07 92 00 - Joint Sealants.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

**Part 3 Execution**

**3.1 COORDINATION AND COOPERATION**

- .1 Coordinate and cooperate with other trades as required to ensure continuity of air barrier and vapour retarder performance at entire enclosure perimeter. Tie-in to adjacent systems as required, and seal transitions.

**3.2 EXAMINATION AND PREPARATION**

- .1 Verify that surfaces and conditions are ready to accept work of this section.
- .2 Ensure surfaces are clean, dry, sound, smooth, and continuous, and comply with air barrier manufacturer's requirements.
- .3 Remove loose or foreign matter, which might impair adhesion of materials.
- .4 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.
- .5 Do not install materials during rain or snowfall.
- .6 Report unsatisfactory conditions to Consultant in writing.
- .7 Do not start work until deficiencies have been corrected. Beginning of Work implies acceptance of conditions.
- .8 Gaps greater than 12 mm shall have sheet metal backing installed, to Section 07 62 00 – Metal Flashing and Trim.

**3.3 POLYETHYLENE VAPOUR BARRIER – INTERIOR APPLICATIONS**

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior assemblies as indicated on Drawings prior to installation of gypsum board to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.



- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed, or replace sheets if localized repair is ineffective.
- .5 Exterior Surface Openings:
  - .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.
- .6 Perimeter Seals:
  - .1 Seal perimeter of sheet vapour barrier as follows:
    - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
    - .2 Lap sheet over sealant and press into sealant bead.
    - .3 Install staples through lapped sheets at sealant bead into wood substrate.
    - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .7 Lap Joint Seals:
  - .1 Seal lap joints of sheet vapour barrier as follows:
    - .1 Attach first sheet to substrate.
    - .2 Apply continuous bead of sealant over solid backing at joint.
    - .3 Lap adjoining sheet minimum 6" and press into sealant bead.
    - .4 Install staples through lapped sheets at sealant bead into wood substrate.
    - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .8 Electrical Boxes:
  - .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
    - .1 Install moulded box vapour barrier. Wrap boxes with film sheet providing minimum 12" perimeter lap flange.
    - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

### **3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.3 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section includes requirements for the supply and installation of aluminum composite panel systems as indicated.
- .2 Canopies: Section includes requirements for cladding and waterproofing the canopies at roofs, facias and soffits, including transitions and terminations.

**1.2 RELATED REQUIREMENTS**

- .1 Division 05 structural steel.
- .2 Section 05 50 00 - Metal Fabrications.
- .3 Section 06 10 00 - Rough Carpentry.
- .4 Section 07 21 13 - Board Insulation.
- .5 Section 07 21 16 - Fibrous Insultation.
- .6 Section 07 21 29 - Spray Applied Polyurethane Foam.
- .7 Section 07 46 19 - Preformed Metal Cladding.
- .8 Section 07 92 00 - Joint Sealants.
- .9 Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.3 REFERENCES**

- .1 Aluminum Association, Inc. (AA)
  - .1 DAF-45, Designation System for Aluminum Finishes.
- .2 American Aluminum Manufacturers Association (AAMA):
  - .1 AAMA 2605-22, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .3 ASTM International (ASTM)
  - .1 ASTM A240/A240M-25, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .2 ASTM A480/A480M-25, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .3 ASTM A653/A653M-23, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A755/A755M-18(2024), Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
  - .5 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .6 ASTM C297/C297M-16(2024), Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions.
  - .7 ASTM C1177/C1177M-24, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .8 ASTM D523-14(2018), Standard Test Method for Specular Gloss.

- .9 ASTM D1781-98(2021), Standard Test Method for Climbing Drum Peel for Adhesives.
- .10 ASTM E283/E283M-19, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .11 ASTM E330/E330M-14(2021), Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .12 ASTM E331-00(2023), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- .4 Canadian Roofing Contractors Association (CRCA)
  - .1 CRCA Roofing Specifications Manual.
- .5 Canadian Sheet Steel Building Institute (CSSBI)
  - .1 CSSBI 20M-2015, Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications.
  - .2 CSSBI S8-2018, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
- .6 CSA Group
  - .1 CSA S136-16(R2021), North American Specification for the Design of Cold Formed Steel Structural Members.
  - .2 CSA S157-17/S157.1-17(R2022), Strength Design in Aluminum / Commentary on CSA S157-17, Strength Design in Aluminum.
  - .3 CSA W47.2-11(R2020), Certification of companies for fusion welding of aluminum, Includes Update No. 1 (2011), Update No. 2 (2012).

#### **1.4 DESIGN CRITERIA**

- .1 The design, fabrication and erection of a complete aluminum building panel system is the responsibility of this subcontractor and is based on the performance criteria specified.
- .2 Design and install specified aluminum panel systems and all connections to withstand earthquake forces in accordance with the requirements of OBC.
- .3 The specified aluminum panel assemblies shall be designed to accommodate weather-induced movements and earthquake forces without breakage, dislodgment or connection failure.
- .4 Wind and suction loads normal to the plane of the assembly shall be calculated in accordance with the OBC.
- .5 The aluminum panel systems, including connection hardware, seismic bracing and anchorage, and all related components shall be designed to withstand specified positive and negative wind load pressure at a maximum deflection of L/180 under full loading.
- .6 Provide for free noiseless thermal movement of components as may be caused by a temperature variation.
- .7 Allow for movement in cladding caused by deflection in structure.
- .8 Design wall system to allow for the unobstructed movement of air between the exterior and interior sides of metal cladding in accordance with industry accepted rain screen principles.

- .9 Ensure panel exhibits no permanent deformation when subject to design criteria specified.
- .10 The system shall provide clear internal paths of drainage in order to drain any trapped moisture to the exterior, discharging moisture in a manner avoiding staining of architectural finishes, collecting in puddles, formation of unsafe icicles and dripping onto or endangering pedestrians.
- .11 Fasten panel assembly to building structure in a manner which transmits all loads to the main structure without exceeding the capacity of any fastener.
- .12 Individual panels shall be removable without disturbing adjacent panels.
- .13 Panels shall not warp or buckle when under full design loads.
- .14 All fastenings and connectors shall be concealed. Connection and attachment devices shall not cause staining to cladding or other adjoining materials. The anchorage system shall be designed so that the panels are secured yet free-floating, to accommodate expansion and contraction.
- .15 The system shall not incorporate sealant between panel joints. A joint reveal filler strip of same material and colour as panels to be incorporated.
- .16 Anchor assemblies or connection hardware, including all related connections, tracks, girts, seismic bracing, fasteners, etc., for and related to the cladding panels shall be designed, engineered, furnished and installed as required in compliance with the specified design and performance criteria. All such items are schematic and do not necessarily indicate the exact required scope, type, shape or profile. Location and methods of anchoring panels shall be the subcontractor's responsibility, who shall design the cladding panels and connections to suit each specific condition in an acceptable manner complying with requirements specified.
- .17 Panel system shall be in compliance with the OBC and local authorities having jurisdiction.

## **1.5 PRE-INSTALLATION MEETINGS**

- .1 Convene pre-installation meeting one week prior to beginning work of this Section, with Contractor, Consultant, installer, manufacturer's representative to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building trades.
  - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Manufacturer's representative shall also provide frequent inspection visits during the course of work of this Section to assure quality and competence of panel installation.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Division 01 requirements.
- .2 Product Data:
  - .1 Submit manufacturer's published installation instructions and illustrations, technical datasheets, and specifications.
- .3 Submit engineered Shop Drawings:
  - .1 The fire station is classified under the OBC as having a post-disaster importance factor, and must be designed to remain safe, functional and accessible after a disaster in accordance with the OBC.

- .2 The site qualifies as a Site Class D according to the geotechnical report and the structural design Drawings.
- .3 Parts of the Work which might become dislodged or damaged during an earthquake and compromise the safety, accessibility or useability of the building in a post-disaster circumstance must have attachments to structure and seismic bracing and anchorage designed by a delegated design professional engineer (P.Eng.) licensed to practice in Ontario.
  - .1 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .4 Shop Drawings shall detail construction, assembly, profiles, materials, reinforcement installation for all conditions, method of sealing and flashing, sub-structure and accessories, colours and finishes. All materials, recommendations and details describing the proposed use, design and erection procedures for all anchorage shall be documented and fully described on the Shop Drawings.
- .4 Submit samples:
  - .1 Submit duplicate samples of specified finish for preliminary colour section. Sample submittal shall include (third party independent testing agency) affidavit certifying material meets requirements specified herein.
- .5 Field Reports: Submit copies of field reports.
- .6 Submit manufacturer's documentation covering care, cleaning and maintenance of panels for incorporation into the Owner's operating and maintenance manuals.

## **1.7 QUALITY ASSURANCE**

- .1 Fabricator/installer shall be acceptable to the panel manufacturer.
- .2 Retain a professional engineer registered in the province of the Work, to design connections to structure and bracing required to resist earthquake loads in accordance with OBC and Contract Document requirements including, but not limited to, the following:
  - .1 Seal and signature to Shop Drawings requiring structural engineering.
  - .2 Field review of installed components.
- .3 Take field measurements prior to commencement of shop manufacturing and finishing.
- .4 Panel lines, breaks and angles shall be sharp, true and surfaces free from warp or buckle.
- .5 Clearly indicate thickness and dimensions of all parts, fastening and anchoring types and methods, arrangement of sheets and joints, assembly and installation details and methods and special shapes. Verify all dimensions with job conditions before fabricating.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Division 01 requirements.
- .2 Deliver all materials to the site and store in original packages with manufacturer's seals and labels intact.
- .3 Observe proper handling procedures during fabrication, delivery and installation to prevent damage. Replace damaged materials, which are stained, cracked, bent, chipped, scratched or otherwise unsuitable for installation at no additional cost to the Owner.
- .4 Store panels under cover and raised above ground to prevent damage and kept free from dampness and element extremes until required for installation.

## **1.9 ENVIRONMENTAL REQUIREMENTS**

- .1 Environmental conditions for installation of materials shall be within the limits prescribed by the manufacturer of the product.

## **1.10 WARRANTY**

- .1 Warranty Panels against oil canning or buckling due to thermal movement or building structure deflections.
- .2 PVDF Panel Finish: Against non-uniform fading during warranty period to extent that adjacent panels have a gloss and/or colour range greater than originally-accepted samples approved by the Consultant, pitting or other type of corrosion resulting from natural elements in local atmosphere, discolouration, staining or streaking of panel surface. Spray applied Finish Warranty shall be for a period of ten (10) years from date of Substantial performance
- .3 Sealant: Against adhesive or cohesive failure of joints between dissimilar material, fluid, migration, dirt pickup, dirt runoff, chalking or visible colour change on surface or cured sealant.
- .4 Material and workmanship warranty against defects or deficiencies shall be for a period of one (1) year and now date of substantial performance.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Vendors: Subject to compliance with requirements specified in this Section, vendors offering products that may be incorporated into the Work include the following:
  - .1 Alucobond Plus, Alcan Composites Inc.
  - .2 Accumet by Northern Facades Ltd.
  - .3 Alcotex, by Ontario Panelization.
  - .4 Alpolic, Mitsubishi Chemical.
  - .5 Alumitex, by Elemex Architectural Facade Systems.
  - .6 Reynobond, Reynolds American Manufacturing.

### **2.2 PERFORMANCE AND MATERIAL CHARACTERISTICS**

- .1 Installed system shall be thermally broken to prevent thermal transference of exterior temperature conditions to interior assemblies. Design systems accordingly.
- .2 Wall Thermal Design:
  - .1 Wall assembly or interface detail shall meet OBC requirements for continuous insulation.
  - .2 Wall assembly shall not have structural connections (beams, support framing, sub girts, clips) that create thermal bridging.
  - .3 Effective U-values of wall assemblies shall meet or exceed the design requirements of OBC, and Supplementary Standard SB-10 ("SB-10") as amended.
- .3 Structural Design: exterior wall/roof cladding panel assemblies are required to demonstrate the ability to meet the following:
  - .1 Live and dead loads as per OBC and fire station's identification as having a post-disaster importance factor.

- .2 Specified earthquake loads.
- .3 Thermal movements.
- .4 Temperature change.
- .5 Design attachment support framing using performance requirements and design criteria indicated.
- .4 Tolerances:
  - .1 Panel Bow: Maximum 1.0% of panel dimensions in width and length.
  - .2 Panel dimensions: Allowance for field adjustments as recommended by manufacturer, where final dimensions cannot be established by the field measurement before completion of panel manufacturing.
  - .3 Where existing conditions may be examined prior to design and fabrication, it shall be the responsibility of the manufacturer to provide accommodation for necessary adjustment to suit the substrate conditions.
  - .4 Panel lines, breaks and angles shall be sharp, true and surfaces free from warp or buckle

## **2.3 PANEL SYSTEM ACCESSORIES**

- .1 Provide all accessories as required for a complete installation at walls and canopy.
- .2 Reveal Joint Filler: to be same material and colour as panels.
- .3 Panel joints: extruded aluminum full length perimeter frame as detailed on reviewed Shop Drawings.
- .4 Extrusion Finish: shall be mill finish aluminum on concealed side.
- .5 Panel Clips: as recommended by manufacturer.
- .6 Sub-Girt System: meeting aluminum composite panel manufacturer's requirements for panel attachment.

## **2.4 SUPPORT MEMBERS, FASTENERS, CONNECTORS**

- .1 Type, size quantity and spacing of all connectors, supporting track, girts, fasteners and other hardware and anchorage devices for panels as required to suit specified standards.
- .2 Fastening devices between aluminum or aluminum and other materials shall be aluminum or stainless steel that will not permit staining.
- .3 Self-locking fasteners shall be stainless steel with nylon inserts or patches.
- .4 Use Non-Metal shims as required for panel alignment.
- .5 Z-Girt Cladding Support:
  - .1 Locations: for attachment of claddings to primary Z-girt sub-structure or canopy structure/substructure, as per Wall Type W-EX1 and Roof Types R-2 and R-3.
  - .2 Z-girt Cladding Support: confirm z-girt thickness and dimensions with delegated design structural engineer and loads in accordance with Section 01 35 01 - Delegated Design, reviewed engineered Shop Drawings, and as follows:
    - .1 Material: Grade 33 ksi or 50 ksi (depending on material thickness) minimum yield strength, with G60 galvanizing.
    - .2 Top and bottom flanges and centre web material thickness and dimensions (lengths and widths), as per reviewed delegated design engineered Shop Drawings.
    - .3 Perforations in web for moisture weeping.



- .4 Acceptable Materials:
  - .1 Perforated Z-Bar, distributed by Bailey Metal Products Limited
  - .2 or equivalent.
- .6 Wall Type W-EX1: Fasteners for attaching Z-girt cladding support girts through insulation to z-girt substructure:
  - .1 Self-Drilling Screws:
    - .1 Large Flange Hex Self-Drill Point #2 Screws - #10-16 x Length required, complete with integral neoprene or EPDM washer system. Hot dipped galvanized after fabrication.

## **2.5 FLASHING AND TRIM**

- .1 Provide custom factory-fabricated integral companion flashing, trims, end caps and finishing components from same material as the aluminum building panels.
- .2 Provide compartmentalization flashings of min 24 ga. G90/Z275 galvanized steel at building corners, floor levels and any other areas as required to achieve pressure equalization of the panel system; all joints must be weathertight.
- .3 Finish: factory-prefinished with PVDF coating; custom colour to match sample.
- .4 Flashing and Trims: factory-prefinished in accordance with Section 07 62 00.
- .5 Colours: to match exposed face of adjacent construction.

## **2.6 ROOF CANOPY MATERIALS (R-2)**

- .1 Structure: to Section 13 34 19 - Pre-engineered Metal Building RFQ.
- .2 Fluted metal deck: refer to structural Drawings.
- .3 Aluminum composite panels and z-girt cladding support system, colours as selected by Consultant from manufacturer's full range
  - .1 Locations: fascia and soffit.
- .4 Provide complete two-ply SBS-modified roofing membrane system, including primer, base sheet, membrane flashing, cap sheet, and all accessories as required for a complete waterproof installation, as per roofing manufacturer's published data sheets, specifications and standard details. Ensure continuity of waterproofing at upturns, downturns and other transitions and terminations.
  - .1 Location: canopy roof.
  - .2 Standard of Acceptance:
    - .1 Primer: Elastocol Stick, Soprema.
    - .2 Base sheet: Colply Base 410, Soprema.
    - .3 Cap sheet: Colply Cap-450, Soprema.
    - .4 Self-adhesive membrane flashing: Sopraflash Stick, Soprema.
    - .5 Adhesives: Colply-system adhesives as recommended by manufacturer, Soprema.
    - .6 Accessories: as required for a complete waterproof installation, and as recommended by the roofing manufacturer.
- .5 Tapered insulation: as required to provide positive slope to drain; submit Shop Drawings showing layout of tapered insulation.
  - .1 Location: canopy roof.
  - .2 Standard of Acceptance:

- .1 Sopra-ISO Plus, Soprema.
  - .2 Insulation adhesive: Duotack Adhesive, Soprema.
- .6 Fascia and soffit waterproofing membrane:
  - .1 Locations: canopy fascia and soffit.
  - .2 High-temperature self-adhered roofing underlayment designed for superior performance in demanding conditions, withstanding temperatures up to 260°F (127°C). It combines a proprietary rubberized asphalt adhesive with a high-performance polymeric film featuring UV barrier properties. The adhesive is shielded by a foldless release paper, which is easily removed during application to allow for a secure bond to sheathing. An embedded proprietary feature provides a "split release on demand" capability, facilitating application in detail areas. It seals tightly around fasteners, preventing water leakage caused by ice dams or wind-driven rain.
  - .3 Provide all accessories as required for a complete waterproof installation, continuous at roof, fascia and soffit.
  - .4 Standard of Acceptance:
    - .1 Grace Vycor™ Ice & Water Shield® HT, or approved equivalent, complete with recommended primer.
- .7 Roof Sheathing:
  - .1 Location: upper canopy roof and fascia surfaces.
  - .2 Provide supporting structure and blocking as necessary to adequately support sheathing.
  - .3 Pre-primed glass mat faced exterior grade gypsum sheathing board designed for roofing applications. Meets ASTM C1177.
  - .4 Provide FM-approved fasteners and fastening plates as recommended by sheathing manufacturer for attachment to structure.
  - .5 Standard of Acceptance:
    - .1 DensDeck® Prime Roof Board, by Georgia-Pacific Building Products, or approved equivalent.
- .8 Fascia Sheathing:
  - .1 Exterior grade plywood, to 06 10 00 - Rough Carpentry. Thickness: minimum 16 mm thick. Prime paint all surfaces, including edges and cutouts prior to installation. Prime surfaces as required for proper adhesion of waterproofing membrane systems.
- .9 Soffit Sheathing:
  - .1 Exterior grade plywood, to 06 10 00 - Rough Carpentry. Thickness: minimum 16 mm thick. Prime paint all surfaces, including edges and cutouts prior to installation. Prime surfaces as required for proper adhesion of waterproofing membrane systems.
- .10 Fascia and Soffit: Provide all blocking and substructure support as required for installation of fascia and soffit sheathing, and to support lighting fixtures (fixture supply and installation and connection to power by the electrical trade). Allow for the light fixtures in the design, fabrication and installation of the canopy assembly. Provide FM-approved fasteners and fastening plates as recommended by sheathing manufacturer for attachment to structure.

## **2.7 ROOF CANOPY MATERIALS (R-3)**

- .1 Structure: to Section 13 34 19 - Pre-engineered Metal Building RFQ.
- .2 Fluted metal deck: refer to structural Drawings.
- .3 Aluminum composite panels and z-girt cladding support system, colours as selected by Consultant from manufacturer's full range
  - .1 Locations: upper canopy roof surface, fascia and soffit – to fully clad canopy at all exposed surfaces, vertical and horizontal.
- .4 Continuous waterproofing membrane:
  - .1 Locations: upper canopy roof surface, fascia and soffit.
  - .2 High-temperature self-adhered roofing underlayment designed for superior performance in demanding conditions, withstanding temperatures up to 260°F (127°C). It combines a proprietary rubberized asphalt adhesive with a high-performance polymeric film featuring UV barrier properties. The adhesive is shielded by a foldless release paper, which is easily removed during application to allow for a secure bond to sheathing. An embedded proprietary feature provides a "split release on demand" capability, facilitating application in detail areas. It seals tightly around fasteners, preventing water leakage caused by ice dams or wind-driven rain.
  - .3 Provide all accessories as required for a complete waterproof installation, continuous at roof, fascia and soffit.
  - .4 Standard of Acceptance:
    - .1 Grace Vycor™ Ice & Water Shield® HT, or approved equivalent.
- .5 Roof Sheathing:
  - .1 Location: upper canopy roof and fascia surfaces.
  - .2 Provide supporting structure and blocking as necessary to adequately support sheathing.
  - .3 Pre-primed glass mat faced exterior grade gypsum sheathing board designed for roofing applications. Meets ASTM C1177.
  - .4 Provide FM-approved fasteners and fastening plates as recommended by sheathing manufacturer for attachment to structure.
  - .5 Standard of Acceptance:
    - .1 DensDeck® Prime Roof Board, by Georgia-Pacific Building Products, or approved equivalent.
- .6 Fascia Sheathing:
  - .1 Exterior grade plywood, to 06 10 00 - Rough Carpentry. Thickness: minimum 16 mm thick. Prime paint all surfaces, including edges and cutouts prior to installation. Prime surfaces as required for proper adhesion of waterproofing membrane systems.
- .7 Soffit Sheathing:
  - .1 Exterior grade plywood, to 06 10 00 - Rough Carpentry. Thickness: minimum 16 mm thick. Prime paint all surfaces, including edges and cutouts prior to installation. Prime surfaces as required for proper adhesion of waterproofing membrane systems.

- .1 Fascia and Soffit: Provide all blocking and substructure support as required for installation of fascia and soffit sheathing, and to support lighting fixtures (fixture supply and installation and connection to power by the electrical trade). Allow for the light fixtures in the design, fabrication and installation of the canopy assembly. Provide FM-approved fasteners and fastening plates as recommended by sheathing manufacturer for attachment to structure.

## **2.8 JOINT SEALANT**

- .1 Silicone sealant in accordance with Section 07 92 00.

## **2.9 FABRICATION**

- .1 Fabricate as required to incorporate structural thermal break material.
- .2 Machine fabricated all material in accordance with reviewed shop drawings with straight lines, square corners or smooth bends, free from twists, kinks, warps, dents, and other imperfections which may affect appearance or serviceability.
- .3 Provide reinforced panels as required to meet the tolerances specified above.
- .4 System shall have a flush appearance from the exterior with no reveal other than module joint width.
- .5 Panels shall be aligned with no lap or reveal other than joint width to permit expansion and contraction.
- .6 Thickness of the metal and details of assembly and support shall provide sufficient strength and stiffness to resist distortion of finish surface. Exposed edges and ends of metal shall be dressed smooth, free from sharp edges and with no uniform minimum radius corners. Connections and joints exposed to weather shall be constructed to exclude water.
- .7 Fasteners shall be concealed.
- .8 Back of panels shall be sealed to perimeter framing with continuous bead of silicone sealant.
- .9 All necessary holes shall be drilled and clip attachments applied before application of finish.
- .10 Trim and flashing shall be factory-fabricated ready for assembly.
- .11 Design and fabricate appropriate type, size, quantity and spacing of all sub-connectors, girts, fasteners and other anchorage devices as required to suit the specified standards.
- .12 Sub-girts shall be perforated at regular intervals to permit drainage of cavity.

## **2.10 FINISH**

- .1 Finish: 2-coat PVDF finish to AAMA 2605.
- .2 Colours as selected by Consultant from manufacturer's full range; allow for 3 colours at canopy (one for roof, one for fascia and one for soffit). Allow for two colours at walls.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's published installation instructions and illustrations, technical datasheets, and specifications.

### **3.2 INSPECTION**

- .1 Inspect the work of the others upon which the work of this section depends and report in writing to the Consultant any defects which would impair the performance of the work.

### **3.3 PREPARATION**

- .1 Obtain all dimensions from job site.
- .2 Ensure all structural support is aligned and condition is acceptable.
- .3 Building surfaces shall be smooth, clean and dry, and free from defects detrimental to the installation of the system. Notify Contractor of conditions not acceptable for installation of system.
- .4 Inspect wall system and components before installation and verify that there is no shipping damage.
- .5 Do not install damaged panels; repair or replace as required for smooth and consistent finished appearance.
- .6 Coordinate and cooperate with other trades as required to meet project schedule.
- .7 Coordinate dimensions, tolerances, and method of attachment with other Work.
- .8 Supply anchorage devices and inserts to the appropriate sections where required for building in or casting-in-place and instruct as to proper location and position. Anchors shall have three-way adjustments.

### **3.4 AIR AND VAPOUR BARRIER**

- .1 Coordinate seal of window assemblies to adjacent air and vapour barrier materials.
- .2 Install materials to ensure continuity of air barrier and vapour retarder control system.
- .3 Cooperate with other trades as required to ensure that overlaps of air barrier and vapour retarder materials shed water to the exterior, and are shingled accordingly.

### **3.5 FLASHING**

- .1 Install flashing, to Section 07 62 00 - Sheet Metal Flashing and Trim.

### **3.6 SUBSTRUCTURE**

- .1 Coordinate with the metal panel manufacturer to integrate thermal-break material into the overall installation.
- .2 Install girt and clip assemblies in accordance with manufacturer's instructions and approved submittals and the following:
  - .1 Install in proper relationship with adjacent materials.
  - .2 Field-verify girt spacing relative to steel support locations and other points of attachment.
  - .3 Protect from damage until acceptance.

### **3.7 ERECTION**

- .1 All erection work is the responsibility of the installation team and be carried out by manufacturer's trained erection crew in accordance with reviewed shop drawings, manufacturer's specifications and compliance with the Contract Documents.
- .2 Erect panels plumb, true and level and in correct alignment with established lines and elevation shown on reviewed shop drawings.

- .3 Set all panels in locations shown on the details and shall be level, square and plumb with correct elevations and in alignment with other work.
- .4 Install all girts, clips, anchors, and flashing securely to surrounding construction spaced to afford maximum rigidity.
- .5 Provide all holes for mechanical and electrical services, piping, louvers, etc., penetrating panels. Provide watertight flanges, flashings, reinforcing and sealant around all penetrations exposed to the weather and or as shown on the drawings.
- .6 Joints shall not be less than their dimensioned width or more than five percent (5%) greater than their dimensioned width at any location along their full length and shall not be wavy, out of line or of different width panel to panel.
- .7 Installed panels shall not deviate from overall plane or alignment more than 1.5mm (1/16 in) in 900mm (36 in). Adjacent panels shall not deviate from plane and alignment by more than 0.79mm (1/32 in) along their length.

### **3.8 SEALANTS**

- .1 Install sealant to penetrations through panels and at junctions with dissimilar materials in accordance with Section 07 92 00.

### **3.9 CANOPY ROOFS TYPES R-2 AND R-3**

- .1 Structural steel and connections to adjacent construction: to Section 13 34 19 Pre-engineered Metal Building RFQ.
- .2 Steel deck: shall be supplied and installed as per structural design Drawings.
- .3 Roof, Fascia and Soffit Sheathing:
  - .1 Secure boards to fluted deck, substructure and blocking as per reviewed Shop Drawings and board manufacturer's published installation instructions.
  - .2 Secure using manufacturer's recommended fastener system, complete with hot dipped galvanized plates and hot dipped galvanized self-drilling fasteners. Fasteners and plates shall be FM-approved.
  - .3 At roof deck, edge joints should be located on and parallel to deck flutes. End joints of adjacent lengths should be staggered.
  - .4 Boards shall be installed with ends and edges butted tightly.
  - .5 Plywood must be prime painted at face and edges and cutouts prior to installation.
    - .1 Prime bonding surface with primer recommended by waterproofing membrane manufacturer prior to installing waterproofing.
- .4 Waterproofing – Roof Type R-2:
  - .1 Install two-ply SBS-modified asphalt roofing system at canopy roof, as per CRCA Roofing Specifications Manual specifications, and published installation instructions by the roofing system manufacturer.
  - .2 Install tapered insulation as required to provide positive slope to drain, fully adhered to sheathing using roofing manufacturer's recommended insulation adhesive.
  - .3 Install two-ply SBS-modified asphalt roofing system over insulation, fully adhered using roofing manufacturer's recommended adhesive. Treat upturns, downturns, transitions and terminations as required to ensure continuity of waterproofing and proper shedding of water by shingling membrane system over fascia waterproofing before installation of fascia cladding.

- .4 Ensure roof waterproofing system is shingled over fascia membrane, and fascia membrane is shingled over soffit membrane.
- .5 Soffit and Fascia Waterproofing:
  - .1 Install waterproofing on canopy sheathing surfaces at fascia and soffit. Comply with manufacturer's published installation instructions including but not limited to the following:
  - .2 Schedule installation such that underlayment is covered by roofing within the published exposure limit of the underlayment.
  - .3 Do not install underlayment on wet or frozen substrates.
  - .4 Install when surface temperature of substrate is a minimum of 40 degrees F (5 degrees C) and rising.
  - .5 Remove dust, dirt, loose materials and protrusions from deck surface.
  - .6 Install membrane on clean, dry, continuous structural deck. Fill voids and damaged or unsupported areas prior to installation.
  - .7 Install membrane such that all laps shed water. Work from the low point to the high point of the roof at all times. Following placement along the fascia, continue application of the membrane up the roof. Membrane may be installed either vertically or horizontally after the first horizontal course.
  - .8 Side laps minimum 3-1/2 inches (89 mm) and end laps minimum 6 inches (152 mm) following lap lines marked on underlayment.
  - .9 Patch penetrations and damage using manufacturer's recommended methods.
- .5 Waterproofing – Roof Type R-3:
  - .1 Installation: Install waterproofing on all canopy sheathing surfaces at roof, fascia and soffit.
  - .2 Ensure roof waterproofing membrane is shingled over fascia membrane, and fascia membrane is shingled over soffit membrane.
  - .3 Comply with manufacturer's published installation instructions including but not limited to the following:
    - .1 Schedule installation such that underlayment is covered by roofing within the published exposure limit of the underlayment.
    - .2 Do not install underlayment on wet or frozen substrates.
    - .3 Install when surface temperature of substrate is a minimum of 40 degrees F (5 degrees C) and rising.
    - .4 Remove dust, dirt, loose materials and protrusions from deck surface.
    - .5 Install membrane on clean, dry, continuous structural deck. Fill voids and damaged or unsupported areas prior to installation.
    - .6 Install membrane such that all laps shed water. Work from the low point to the high point of the roof at all times. Following placement along the fascia, continue application of the membrane up the roof. Membrane may be installed either vertically or horizontally after the first horizontal course.
    - .7 Side laps minimum 3-1/2 inches (89 mm) and end laps minimum 6 inches (152 mm) following lap lines marked on underlayment.
    - .8 Patch penetrations and damage using manufacturer's recommended methods.

- .6 Aluminum composite panels (Roof Types R-2 and R-3):
  - .1 Install required substructure, blocking and Z-Girt Cladding Support system as per reviewed Shop Drawings.
  - .2 Install aluminum composite panel system to canopies as indicated on Drawings, reviewed Shop Drawings, and the requirements of this Section.
- .7 Coordinate and cooperate with other trades as required for installation of lighting, structure and fluted deck.

### **3.10 FIELD QUALITY CONTROL**

- .1 The delegated design engineer shall be responsible for production of Shop Drawings and shall provide periodic inspections during construction as required. Such inspections and associated costs shall be included in Contract Price.
- .2 At completion of the work, the delegated design engineer shall submit to the Consultant copies of field review reports for each site visit made and a final signed and sealed letter of assurance of "professional field review" and "compliance" indicating that all aluminum building panels have been installed in accordance with the manufacturer's specifications, the standards specified herein and the final reviewed shop drawings.

### **3.11 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.12 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.13 SCHEDULE**

- .1 Refer to Drawings for locations and construction details.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 05 structural steel.
- .2 Section 05 50 00 - Metal Fabrications.
- .3 Section 07 21 13 - Board Insulation.
- .4 Section 07 21 16 - Fibrous Insulation.
- .5 Section 07 21 29 - Spray Applied Polyurethane Foam.
- .6 Section 07 42 42 - Aluminum Composite Panels.
- .7 Section 07 92 00 - Joint Sealants.
- .8 Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A755/A755M-18(2024), Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
  - .3 ASTM A792/A792M-23, Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .4 ASTM D1187/D1187M-97(2024), Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
- .2 CSA Group (CSA)
  - .1 CSA G40.20-13/G40.21-13(R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CSA S136-16 (R2021), North American specification for the design of cold-formed steel structural members.
  - .3 CSA W59:24, Welded Steel Construction (Metal Arc Welding).
  - .4 CSA W55.3-08(R2023), Certification of companies for resistance welding of steel and aluminum.
- .3 Canadian Sheet Steel Building Institute (CSSBI)
  - .1 CSSBI B8-2015: Buildings Incorporating Steel Building Systems: Responsibilities of the Parties Involved.
  - .2 CSSBI B20-15: Thermal Transmittance of Insulated Sheet Steel Wall and Roof Assemblies.
  - .3 CSSBI 20M-17: Standard for Sheet Steel Cladding for Industrial, Commercial and Institutional Building Applications.
  - .4 CSSBI SSF 42-15: Fastening Prepainted Sheet Steel Roofing and Siding.
  - .5 CSSBI SSF 44-16: Thermal Transmittance of Insulated Metal Building Wall and Roof Assemblies.
- .4 Metal Building Manufacturers Association (MBMA)
  - .1 MBMA Metal Building Systems Manual, 2024 Edition.

### **1.3 WALL ASSEMBLY**

- .1 The wall assembly for W-EX1 is as shown on Drawings and reviewed engineered Shop Drawings.
  - .1 Preformed metal cladding as specified, vertical orientation.
  - .2 25 mm slotted/ventilated/drainage z-girts (z-girt cladding support).
  - .3 Minimum R10 (RSI 1.76) rigid board insulation, to Section 07 21 13 - Board Insulation, with joints, transitions and penetrations sealed as required to form the air/moisture barrier at the exterior walls. Seal all penetrations of board, joints and terminations.
  - .4 Minimum R28 (203 mm thick) Type 1 fibreglass thermal batt insulation as required to fill entire girt cavities, to Section 07 21 16 - Fibrous Insulation.
  - .5 203 mm galvanized metal z-girt substructure, as per reviewed engineered Shop Drawings.
  - .6 Wall Types W-P2a and W-P2b as indicated on Drawings.

### **1.4 PRE-INSTALLATION MEETING**

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor, installer, manufacturer's representative to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building subtrades.
  - .4 Schedule for installation of insulation, air/vapour barrier, sheathing, and structural metal stud framing.
  - .5 Review manufacturer's installation instructions and warranty requirements.
- .2 Manufacturer's representative shall also provide inspection visits during the course of work of this Section to verify quality of work meets specifications.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures:
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet.
- .3 Submit engineered Shop Drawings:
  - .1 The fire station is classified under the OBC as having a post-disaster importance factor, and must be designed to remain safe, functional and accessible after a disaster in accordance with the OBC.
  - .2 The site qualifies as a Site Class D according to the geotechnical report and the structural design Drawings.
  - .3 Parts of the Work which might become dislodged or damaged during an earthquake and compromise the safety, accessibility or useability of the building in a post-disaster circumstance must have attachments to structure and seismic bracing and anchorage designed by a delegated design professional engineer (P.Eng.) licensed to practice in Ontario.
    - .1 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
  - .4 Shop Drawings shall detail construction, assembly, profiles, materials, reinforcement installation for all conditions, method of sealing and flashing, substructure and accessories, colours and finishes. All materials, recommendations and details describing the proposed use, design and erection procedures for all anchorage shall be documented and fully described on the Shop Drawings.

- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm samples of wall system, representative of materials, finishes and colours.
  - .2 Prior to ordering materials, provide to consultant the following for verification purposes: three samples of colour of finish specified.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

## **1.6 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.
- .3 Installer Qualifications: Engage experienced installer, with a minimum of 5 years experience, who has completed systems similar in material, design, and extent to that indicated for Project and with record of successful performance.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver and store materials in accordance with manufacturer's instructions.
- .2 Protect panels during transportation, unloading, storing, and erecting to prevent bending, warping, twisting, and surface damage.

## **1.8 WARRANTIES**

- .1 Warranties as per the requirements of Section 13 34 19 Pre-engineered Metal Building RFQ.

## **Part 2 Products**

### **2.1 PERFORMANCE AND DESIGN CRITERIA**

- .1 Design metal panel wall system in accordance with OBC, CSA S136, and the requirements of Section 13 34 19 - Pre-engineered Metal Building RFQ.
- .2 Design metal panel wall to provide for thermal movement of component materials caused by ambient temperature range of 60 degrees C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .3 Include expansion joints to accommodate movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.
- .4 Design members to withstand dead load and wind loads calculated in accordance with OBC and applicable local regulations.
- .5 Provide for positive drainage of condensation occurring within wall construction and water entering at joints, to exterior face of wall in accordance with NRC "Rain Screen Principles".
- .6 Effective U-values of wall assemblies shall meet or exceed the design requirements of OBC, and Supplementary Standard SB-10 ("SB-10") as amended.
- .7 Total Wall Assembly: provide minimum thermal resistance as noted on Drawings.
- .8 Permeance through wall system not to exceed 1 ng/(Pa.s.m<sup>2</sup>).

- .9 Design wall system to accommodate specified erection tolerances of structure.
- .10 Design wall system to allow for movement of air between exterior and interior side of metal cladding.
- .11 Provide an effective air barrier, to prevent infiltration and/or exfiltration of air through wall assembly.

## **2.2 STEEL CLADDING MATERIALS**

- .1 Metal Wall Panels: to ASTMA755/A755M, structural steel (SS) grade 230, Type 1 and 2; hot dipped galvanized (to Z275) cold-formed sheet steel, and as follows:
  - .1 Surface: regular spangle.
  - .2 Coil Coating System: Supplier's premium PVDF factory-applied powder coating system, to AAMA 2604; colours as selected by Consultant from manufacturer's full range.
  - .3 Profiles and colours to match the following basis-of-design selections:
    - .1 MTS-1 (Vertical siding - light grey):  
basis-of-design: VicWest channel wall, 26 gauge.
    - .2 MTS-2 (Vertical Siding - dark grey / charcoal):  
basis-of-design: VicWest channel wall, 26 gauge.
    - .3 MTS-3 (Vertical Siding - red):  
basis-of-design: VicWest CL5022, 26 gauge.
    - .4 MTS-4 (Horizontal siding - light grey color same as MTS-1):  
basis-of-design: VicWest channel wall, 26 gauge.
  - .4 Orientation: as indicated on Drawings.
- .2 Liner panel: to match VicWest L-800R, Agway AL-315, or approved equivalent.
  - .1 Nominal Core thickness: 0.5512 mm (26 gauge).
  - .2 Coating System:
    - .1 Exterior face: galvanized Z275 finish.
    - .2 Interior face: SMP-coated, colour as determined by Consultant as a later date.
  - .3 Function: to act as an air/vapour control layer.

## **2.3 INSULATION**

- .1 Rigid board insulation, to Section 07 21 13 - Board Insulation.
- .2 Fibrous insulation, to Section 07 21 16 - Fibrous Insulation.

## **2.4 ACCESSORIES**

- .1 Z-Girt Cladding Support:
  - .1 Locations: for attachment of claddings to primary Z-girt sub-structure (through intervening rigid board insulation which separates the two z-girt systems), as per Wall Type W-EX1.
  - .2 Z-girt Cladding Support: confirm z-girt thickness and dimensions with delegated design structural engineer and loads in accordance with Section 01 35 01 – Delegated Design, reviewed engineered Shop Drawings, and as follows:
    - .1 Material: Grade 33 ksi or 50 ksi (depending on material thickness) minimum yield strength, with G60 galvanizing.

- .2 Top and bottom flanges and centre web material thickness and dimensions (lengths and widths), as per reviewed delegated design engineered Shop Drawings.
  - .3 Perforations in web for moisture weeping.
  - .4 Acceptable Materials:
    - .1 Perforated Z-Bar, distributed by Bailey Metal Products Limited
    - .2 or equivalent.
- .2 Exterior corners shall be of same profile, material and finish as adjacent cladding material, shop cut and brake formed to required angle, concealed corner brace, pop rivet connections with painted head to match cladding.
- .3 Exposed joints (perpendicular to profile): ends of cladding sheet shop cut clean and square, backed with tight fitting filler lapping back of joint, exposed components colour matched to cladding.
- .4 Metal Trim and Flashings: to ASTM A755/A755M, structural steel (SS) grade 230, types 1 and 2; hot dipped galvanized cold rolled sheet steel, 0.61 mm thick before galvanizing; galvanized to Z275; provide as required for a complete, properly drained, rainscreen system.
- .5 Expansion joints: as recommended by manufacturer.
- .6 Gaskets: soft, pliable, cold weather grade, PVC foam, extruded profile for outer sheet.
- .7 Metal Cladding Fasteners:
  - 1. Self-drilling, hot dipped galvanized steel.
  - 2. Head finish:
    - .1 Hot dipped galvanized steel in concealed locations.
    - .2 Pre-painted metal, colour to match prefinished metal panels in exposed locations.
- .8 Fasteners for attaching Z-girt cladding support girts through insulation to z-girt substructure:
  - .1 Self-Drilling Screws:
    - .1 Large Flange Hex Self-Drill Point #2 Screws - #10-16 x Length required, complete with integral neoprene or EPDM washer system. Hot dipped galvanized after fabrication.
- .9 Joint Sealants: as indicated in Section 07 92 00 and as recommended by manufacturer. Colour of exposed sealant to match adjacent panel.
- .10 Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

## 2.5 FABRICATION

- .1 Form prefinished metal panels to profiles indicated with bends sharp and true.
- .2 Fabricate to conform to requirements of Contract Documents and reviewed shop drawings, and to allow for structural movements within the systems.
- .3 Ensure that metal panels are free of steel contamination from rollers.
- .4 Fabricate siding panel systems to prevent entry of water into building and from collection within system assembly.
- .5 Join intersecting parts together to provide tight, accurately fitted joints with adjoining surfaces in true planes.

- .6 Fabricate formed and notched metal closures to close-off flutes at exterior. Seal also with neoprene foam filler.
- .7 Cooperate with applicable sections to ensure coordination required for proper installation of work of this section in conjunction with and incorporated with other work.
- .8 Fabricate metal cladding panels in one length; maximum 6000 mm (20').
- .9 Install panels vertically to layout indicated, unless otherwise indicated.
- .10 Prefinished metal panel terminations shall not have a raw metal edge or exposed fasteners. Panel ends shall be folded.
- .11 Fabricate flashings used in conjunction with the roof parapets with S- locks for concealed fastening unless otherwise specified.

## **2.6 FINISHES**

- .1 Hot dipped galvanizing, to ASTM A653/A653M, coating designation Z275.
- .2 Exterior Coil Coating System: Supplier's premium PVDF factory-applied powder coating system, to AAMA 2604; colours as selected by Consultant from manufacturer's full range.
- .3 Interior: SMP silicone-modified polyester factory-applied coating system; colours as selected by Consultant from manufacturer's full range.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Comply with manufacturer's published installation instructions and illustrations, technical datasheets, and specifications.
- .2 Meet or exceed the requirements of OBC and published amendments.
- .3 Meet the requirements of Section 13 34 19 - Pre-engineered Metal Building RFQ.

### **3.2 EXAMINATION**

- .1 Verification of Conditions:
  - .1 Examine substrates to receive work and surrounding adjacent surfaces for conditions affecting installation. Coordinate with related sections to ensure proper dimensions are maintained.
  - .2 Verify site dimensions by accurate field measurements so that work will be accurately designed, fabricated and fitted to the structure.
  - .3 All penetrations through the façade for the work of other trades shall be fitted with a watertight sleeve. Verify flashings are in place, sealed with waterproof membrane and covered with building membranes.
  - .4 Maintain sheathing membrane integrity.
- .2 Notify Consultant in writing of any conditions that are not acceptable.
- .3 Proceed with installation after verification and correction of surface conditions acceptable to manufacturer. Commencement of work means acceptance of conditions.

### **3.3 COORDINATION**

- .1 Coordinate and cooperate with other trades as required to maintain project schedule.

### **3.4 GENERAL FASTENER REQUIREMENTS**

- .1 Use self-tapping metal screws provided by the siding manufacturer. Set the screws with moderate contact on the clip part of the panel to avoid impeding the expansion of the metal. The screws must not exert any upward or downward pressure to avoid deforming the siding or opening the panels at the joints. A systematic check of the work must be done for every three or four panels placed in order to detect possible anomalies. Remove the protective film from the siding prior to installation to facilitate a good visual inspection of the quality of the installation and in order to make appropriate corrections as installation progresses.
- .2 Protect unpainted galvanized and non-ferrous metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or non-metallic flashing.

### **3.5 PREPARATION**

- .1 Clean surfaces thoroughly prior to installation.
- .2 Repair substrate flaws or defects before applying siding or soffits.

### **3.6 INSTALLATION**

- .2 Install liner panels, sub-structure system and face panel assembly in accordance with manufacturer's installation instructions and requirements of the Contract Documents.
- .3 Coordinate with requirements of other sections for work penetrating or mounted on metal cladding systems. Provide concealed framing as required to support light fixtures or other devices to be mounted on wall system.
- .4 Erect wall system complete with liner panels, insulation, flashings forming part of the system, fasteners, closures and sealants to meet design intent.
- .5 Cut, flash, and apply sealant to system penetrations.
- .6 Erect panels in straight lines that are true, level, and plumb.
- .7 Allow for differential thermal and structural movement between systems and structure as well as between elements of system.
- .8 Install cap flashings, drip flashings, internal corner flashings, closures and corners, of same material and finish as exterior cladding, brake formed to shape. Close all flute ends.
- .9 Install sealant between work of this section and work of other sections to meet specified requirements of Section 07 92 00 and to provide a watertight installation.
- .10 Spacer and girt system: galvanized steel adjustable girt and clip system designed to meet performance requirements specified. System to be thermally isolated, to minimize heat transfer through wall assemblies.
- .11 Fasten clips through air barrier to supporting work and seal. Fasten girts to clips at required spacing. Provide additional framing at termination, openings, and penetrations.
- .12 Install exterior wall skin with joints accurately aligned and tight fitting. Provide cladding panels in longest available lengths to layout indicated. Horizontal intermediate joints are not permitted unless indicated on drawings and approved by Consultant.
- .13 Provide sealants, flashings, closures, covers, and trim as indicated and as required to render work complete and finished in accordance with specified requirements.
- .14 Coordinate with roofing trades where prefinished metal cladding system to be provided adjacent to a roof assembly. Connections to be watertight and airtight.

- .15 Comply with siding manufacturer's detailed guidelines at windows and doors.

### **3.7 CONSTRUCTION TOLERANCES**

- .1 Maintain the following installation tolerances:
  - .1 Maximum variation from plane or location shown on reviewed shop drawings: 20 mm/10 m of length and up to 30 mm/100 m maximum.
  - .2 Maximum offset from true alignment between two adjacent members abutting end to end, in line: 1 mm (0.039").

### **3.8 FIELD QUALITY CONTROL**

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- .2 Manufacturer's field services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Submit reports to Consultant within three days of review and submit.

### **3.9 ADJUSTMENT AND CLEANING**

- .1 After erection, touch up coatings removed or damaged during erection.
- .2 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.
- .3 Wash down exposed interior and exterior surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths. Wipe interior surfaces clean as part of final clean-up.
- .4 Remove excess sealant with recommended solvent.
- .5 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .6 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .1 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.10 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.11 SCHEDULE**

- .1 Install as per pre-engineered metal building supplier's reviewed engineered Shop Drawings and Drawings.

**END OF SECTION**



**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 05 41 00 - Structural Metal Stud Framing.
- .2    Section 05 50 00 - Metal Fabrications.
- .3    Section 06 10 00 - Rough Carpentry.
- .4    Section 07 21 13 - Board Insulation.
- .5    Section 07 21 16 - Fibrous Insulation.
- .6    Section 07 21 29 - Spray Applied Polyurethane Foam.
- .7    Section 07 62 00 - Sheet Metal Flashing and Trim.
- .8    Section 07 92 00 - Joint Sealants.
- .9    Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2            REFERENCES**

- .1    Building Design Codes
  - .1    Ontario Building Code and amendments.
- .2    Build Design Codes - Uplift, Live and Dead Loads
  - .1    ASCE 7-22, Minimum Design Loads and Associated Criteria For Buildings and Other Structures.
- .3    ASTM International (ASTM)
  - .1    ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2    ASTM A755/A755M-18(2024), Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
  - .3    ASTM A792/A792M-23, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.
  - .4    ASTM B117-19, Standard Practice for Operating Salt Spray (Fog) Apparatus
  - .5    ASTM D523-14(2018), Standard Test Method for Specular Gloss.
  - .6    ASTM D822-23, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
  - .7    ASTM E1592- 05(2017), Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
  - .8    ASTM E1646-95(2018), Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
  - .9    ASTM E1680-16(2022), Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
  - .10   ASTM E2112-23, Standard Practice for Installation of Exterior Windows, Doors and Skylights.
- .4    Canadian Roofing Contractors Association (CRCA)
  - .1    CRCA Roofing Specifications Manual.
- .5    CSA Group (CSA)
  - .1    CSA S136-16 (R2021), North American specification for the design of cold-formed steel structural members.

- .6 Canadian Sheet Steel Building Institute (CSSBI)
  - .1 CSSBI B8-2015: Buildings Incorporating Steel Building Systems: Responsibilities of the Parties Involved.
  - .2 CSSBI B20-15: Thermal Transmittance of Insulated Sheet Steel Wall and Roof Assemblies.
  - .3 CSSBI 20M-17: Standard for Sheet Steel Cladding for Industrial, Commercial and Institutional Building Applications.
  - .4 CSSBI SSF 42-15: Fastening Prepainted Sheet Steel Roofing and Siding.
  - .5 CSSBI SSF 44-16: Thermal Transmittance of Insulated Metal Building Wall and Roof Assemblies.
- .7 Metal Building Manufacturers Association (MBMA)
  - .1 MBMA Metal Building Systems Manual, 2024 Edition.
- .8 National Research Council Canada (NRC)/Institute for Research in Construction (IRC) - Canadian Construction Materials Centre (CCMC)
  - .1 CCMC Registry of Product Evaluations.
- .9 Ontario Sheet Metal Contractors Association (OSMCA)
- .10 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 Architectural Sheet Metal Manual, 7th Edition, 2012.
- .11 Underwriters Laboratories Canada (ULC):
  - .1 ULC 107-10, Methods of Fire Tests of Roof Coverings (CAN/ULC S107-10)

### 1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning work of this Section, with Contractor, Consultant, installer, manufacturer's representative in accordance with Section 01 32 16 - Construction Schedule to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building trades.
  - .4 Review manufacturer's installation instructions, and warranty requirements.
  - .5 Ensure installer qualifications and certifications, roofing system, and intended installation procedures meet CRCA warranty requirements.
- .2 General Contractor to coordinate metal building contractor and photovoltaic system contractor for the installation of the photovoltaic rooftop panel system, including connections to roofing system to ensure scopes of work are clear and cooperation confirmed as required to meet the construction schedule and proper sequencing of the Work.

### 1.4 PERFORMANCE AND DESIGN REQUIREMENTS

- .1 Design the standing seam roof system to safely resist the positive and negative loads as required for the location and type of project designed.
- .2 Effective U-values of roof system shall meet or exceed the design requirements of OBC, and Supplementary Standard SB-10 ("SB-10") as amended.
- .3 The fire station is classified under the OBC as having a post-disaster importance factor, and must be designed to remain safe, functional and accessible after a disaster in accordance with the OBC.

- .4 The site qualifies as a Site Class D according to the geotechnical report and the structural design Drawings.
  - .1 Parts of the Work which might become dislodged or damaged during an earthquake and compromise the safety, accessibility or useability of the building in a post-disaster circumstance must have attachments to structure and seismic bracing and anchorage designed by a delegated design professional engineer (P.Eng.) licensed to practice in Ontario.
    - .1 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .5 Shop Drawings shall detail construction, assembly, profiles, materials, reinforcement installation for all conditions, method of sealing and flashing, sub-structure and accessories, colours and finishes. All materials, recommendations and details describing the proposed use, design and erection procedures for all anchorage shall be documented and fully described on the Shop Drawings
- .6 Design and install panel system and all connections to withstand earthquake forces, snow loads and wind loads in accordance with the requirements of the OBC. Pull out resistance of fasteners shall be 1 kN or greater. Point load capacity per 100 mm diameter shall be 1.8 kN or greater.
- .7 Determine structural-uniform uplift load capacity of the panel system in accordance with the principles of ASTM E1592, "Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
- .8 The Factor of Safety on the test results shall be 1.65 for the panel and clip/halter ultimate loads with no increase for wind.
  - .1 The Factor of Safety for fasteners shall be 3.0 for single fastener in each connection, 2.25 for 2 or more fasteners in each connection and 4.0 in masonry.
  - .2 Design uplift capacity for condition of gage, span or loading other than those tested may be determined by interpolation of test results.
  - .3 Deflection shall be  $l/180$  for positive loading.
- .9 Water penetration of the panel assembly at 20 psf pressure for 15 minutes shall have "no uncontrollable leakage" when tested in accordance with ASTM E1646.
- .10 The system shall provide clear internal paths of drainage in order to drain any trapped moisture to the exterior, discharging moisture in a manner avoiding staining of architectural finishes, collecting in puddles, formation of unsafe icicles and dripping onto pedestrians.
- .11 Provide flashing as shown and required to make the system wind and watertight, and still allow for thermal movement.
- .12 Air infiltration of panel assembly at 20psf pressure shall be no more than 0.02 cfm/sf of panel when tested in accordance with ASTM E1680.
- .13 The panel system shall have a CAN/ULC S107 (Method of Fire Tests of Roof Coverings) rating.
- .14 Fasten the roofing panels to the structure through the use of concealed halters/clips which are designed to allow for up to and including a full 95 mm of panel movement without impeding the performance of the panel.
- .15 Fasten panel assembly to building structure in a manner, which transmits all loads to the main structure without exceeding the capacity of any fastener.
- .16 Thermal Movements: The metal wall and associated flashing systems shall be so designed and constructed as to provide for such expansion and contraction of component materials as will be caused by an ambient temperature range of -40°C to +60°C without

causing harmful buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

- .17 Provide and/or make allowances for free noiseless vertical and horizontal thermal and wind loading movement, due to the contraction and expansion of any and all component parts.
- .18 Roll Forming Equipment to have a minimum of twelve hardened tooling roll forming stations with a profiled shear. Pre-shearing and portable roll forming equipment is strictly prohibited.
- .19 Assembly and erection procedures shall take into account the ambient temperature range and wind pressure at the time of installation.

## 1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit product data:
  - .1 Submit product data sheets for deck covering, underlay, ventilation and drainage mat, insulation.
- .3 Provide certification confirming allow composition and physical properties of metal materials provided for the work of this Section.
- .4 Submit shop drawings:
  - .1 Shop drawings shall be engineered, and bear the stamp and signature of Contractor's delegated design engineer. Include calculations used to establish structural designs. Refer to structural Drawings for wind uplift design assumptions.
  - .2 Attachments to structure shall be designed by a delegated design professional engineer (P.Eng.) licenced to practice in the Province of Ontario.
  - .3 The geotechnical engineer has recommended that the site be classified as "Site Class D" for structural design purposes in the absence of a site-specific dynamic analysis.
    - .1 Design, erect and install roof assembly to meet OBC requirements for Class D seismic conditions, or as otherwise determined by a professional engineer (P.Eng.) licensed to practice in the Province of Ontario based on OBC calculations.
  - .4 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
  - .5 Indicate material thicknesses, arrangements of sheets and joints, details of the assembly, insulation, roof underlayment, ventilation mat system, plywood coverboard, steel angles, thermal clips, dimensions, types and locations of fasteners, attachment to structure, and special shapes and relationship of panels to structural frame, methods of maintaining continuity of thermal, air and vapour control systems at the enclosure, and finishes.
- .5 Submit samples:
  - .1 Submit duplicate 300 x 300mm samples of each sheet metal material.
- .6 Submit proof of manufacturer's CCMC Listing and listing number to Consultant.
- .7 Submit Warranty inspection reports and Warranties to Agency.
- .8 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

## **1.6 QUALITY ASSURANCE**

- .1 Colour Matching: with the siding and roofing to match in colour, supply sheet metal goods from the same factory batch run so the colours of the metal at roof and walls match.
- .2 Installer Qualifications: Engage experienced installer with experience who has completed systems similar in material, design, and extent to that indicated for Project and with record of successful performance. Installer shall be a member of the Canadian Roofing Contractors Association (CRCA) or affiliate organization.
- .3 Obtain each type of metal roofing system through one source from a single manufacturer.
- .4 Inspection: Roofing contractor to obtain inspections during the installation to meet the requirements of the warranty.
- .5 Design, fabricate and install roofing to allow for expansion and contraction of materials without buckling, oil-canning, or other adverse effect.
- .6 Single Source and Coordination: the sheet metal roof and sheet metal walls must be the same product and the ribs must be aligned.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver and store materials in accordance with manufacturer's instructions.
- .2 Protect panels during transportation, unloading, storing, and erecting to prevent bending, warping, twisting, and surface damage.

## **1.8 WARRANTY**

- .1 Warranties as per the requirements of Section 13 34 19 Pre-engineered Metal Building RFQ.

## **Part 2 Products**

### **2.1 ROOF ASSEMBLY DESIGN AND PERFORMANCE REQUIREMENTS**

- .1 Refer to Drawings, Roof Type R-1. Work to be designed and executed in accordance with the requirements of Section 13 34 19 - Pre-engineered Metal Building RFQ.
- .2 Meet or exceed the requirements of the Ontario Building Code.
- .3 Provide design, supply and installation for a complete prefinished metal roof system, including but not limited to roofing, metal pipe snow guards, prefinished gutters and downspouts (downspouts to be connected to the storm water management system), fascia, soffits, integration of mechanical vents, attachment clips, substructures, purlins and connections to building structure, fibrous insulation, thermal blocks, steel liner panel (caulked and sealed as required to form interior vapour control layer), and other elements as shown on the Drawings and as per reviewed engineered Shop Drawings.
- .4 Effective U-values of wall and roof assemblies shall meet or exceed the design requirements of OBC, and Supplementary Standard SB-10 ("SB-10") as amended.

### **2.2 ACCEPTABLE MANUFACTURES**

- .1 The following manufacturers may have a product that may apply to this project. All products must meet the requirements herein specified respecting profile, quality, and method of attachment.
  - .1 Agway Metal Inc.
  - .2 VicWest.

- .3 Pre-engineered metal building supplier's metal roof system meeting the requirements of Section 13 34 19 - Pre-engineered Metal Building RFQ and this Section.

## **2.3 LINER PANELS**

- .1 Liner panel: to match VicWest L-800R, Agway AL-315, or approved equivalent.
  - .1 Nominal Core thickness: 0.5512 mm (26 gauge).
  - .2 Coating System:
    - .1 Exterior face: galvanized Z275 finish.
    - .2 Interior face (facing to the building interior): SMP silicone-modified polyester factory-applied coating system; colours as selected by Consultant from manufacturer's full range.
  - .3 Function: to act as an air/vapour control layer. All seams, joints, holes and penetrations to be sealed as required to ensure continuity of performance.

## **2.4 ROOF INSULATION**

- .1 Provide roof insulation as shown on Drawings, reviewed engineered Shop Drawings, and Section 07 21 16 - Fibrous Insulation.

## **2.5 THERMAL BLOCKS**

- .1 Thermal blocks which interrupt metal-to-metal thermal conductance and are designed to resist design loads at locations installed, supplied and installed in accordance with the Drawings and reviewed engineered Shop Drawings.
  - .1 Locations: where shown on Drawings.
  - .2 Acceptable Materials (selected as required to suit site conditions, design loadings, and installation location):
    - .1 Armatherm 500 thermal break material;
    - .2 Cor-A-Vent Purlin Vent, by Cor-A-Vent;
    - .3 Fabreeka-TIM® structural thermal break, thermal insulation material;
    - .4 Fabreeka-TIM® RF Series, light load structural thermal break material;
    - .5 Fabreeka-TIM® LT15 light load thermal break;
    - .6 Thermal Spacer Block Material (TSBM), by Thermal Bridging Solutions;
    - .7 Thermal Blocks, by Metal Building Insulation;
    - .8 Thermal Blocks, by Nucor Builds Group;
    - .9 or equivalent with same or better physical and performance properties.

## **2.6 CONCEALED THERMAL CLIP SYSTEM**

- .1 Thermal clips for attachment of roof panels to substructure shall be made from 16-gauge (nominal 1.5189 mm thick) galvanized steel, lined with cork tape or similar thermal-break material. Thermal clips shall be paired with sub-girt L-bars or other sub-girt configuration, which are positioned to fit the thickness of the roll-insulation panels and can support roof cladding in a variety of compositions.
- .2 Supply and install concealed thermal clip system, complete with fasteners and substructure Z-girts, C-channels and/or hat-channel systems designed to support roofing panels, resist wind uplift loads and thermal movement, and help prevent thermal bridging.
  - .1 Thermal Clip: 6" x 16-gauge thermally-broken clip (ASTM A653 CS Type B, Z275, minimum yield stress = 33ksi), or similar thermally-broken clip system as per reviewed engineered Shop Drawings.

- .2 L-bar girts: 4" x 1-1/2" x 16-gauge G90 (Z275) (minimum yield stress = 33ksi), or similar girt system as per reviewed engineered Shop Drawings
- .3 Girt-to-thermal clip fasteners: (2) # 14 x 1" self-drilling galvanized screws per bracket, or similar fastener system as per reviewed engineered Shop Drawings

## **2.7 SUPPORT STRUCTURES AND REINFORCEMENT**

- .1 CFS stud framing, to Section 05 41 00 - Structural Metal Stud Framing.
- .2 Metal fabrications, to Section 05 50 00 - Metal Fabrications.
- .3 Exterior grade plywood, to Section 06 10 00 - Rough Carpentry. Prime paint face and edges including holes and cutouts before installing.
- .4 Wood blocking, preservative pressure-treated: to Section 06 10 00 - Rough Carpentry.
- .5 Refer to Drawings for design intent and details.

## **2.8 SHEET METAL MATERIALS**

- .1 Special Requirements:
  - .1 Allow for up to 10 weeks of lead time in project schedule. Sheet metal roofing shall be custom-fabricated to ensure the fewest number of joints in the finished installation as possible. Any joints required shall be standing seam. Sheet metal roofing is required at the top of each of the hip roofs. Material: prefinished steel.
- .2 Aluminum zinc alloy (55% Al / 45% Zn) hot dipped coated steel sheet: to ASTM A792/A792M, SS Grade 50, AZM165 165 g/m<sup>2</sup>, Aluminum-Zinc alloy coated (Galvalume™, by ArcelorMittal Dofasco), and as follows:
  - .1 Standing seam metal roofing panels - light grey: basis of design – Agway AR-50, 24 gauge.
  - .2 Surface: regular spangle.
  - .3 Stiffening Flutes: as required.
  - .4 Galvalume™ Coating System: shall include aluminum-zinc alloy to specifications, factory-applied to both sides of substrate using reverse roll coaters or similar.
  - .5 Exterior Coil Coating System: Supplier's premium PVDF factory-applied powder coating system, to AAMA 2604; colours as selected by Consultant from manufacturer's full range.

## **2.9 ACCESSORIES**

- .1 Provide all prefinished metal pipe snow guards, gutters, downspouts (connected to the storm water management system), metal fascia and soffits, integration of mechanical vents, attachment thermal clips, and required substructure as required for a complete installation.
- .2 Provide all accessories, fasteners, heat-resistant sealants, and other products as required for a complete installation, and suitable for sheet metal roofing applications.
- .3 Hot dipped galvanized steel fabrications, to Section 05 50 00 – Metal fabrications.
- .4 Z-girts, C-channels and hat-channels: to CSA S136; nominal 1.5189 thick or thicker to suit design requirements; ASTM A792/A792M structural steel (SS) Grade 80, AZ60/AZM180, Aluminum-Zinc alloy coated girts and channels (Z275), as per reviewed engineered Shop Drawings. Girt and channel design and use is determined by pre-engineered metal building supplier's reviewed engineered Shop Drawings.

- .5 Provide components required for complete metal roofing system assembly including but not necessarily limited to the following:
  - .1 Gutters, downspouts, fascia, soffits, trim, copings, corner units, ridge cap and closures, concealed hold-down clips, two-piece expansion clips, flashings, sealants, gaskets, fillers, closure strips, and similar items; match material and finish of metal roofing system.
  - .2 Gutters shall be nominal 0.85 mm thick prefinished hot dipped galvanized steel, or as otherwise determined by the pre-engineered metal building supplier.
  - .3 Gutters and downspouts shall be designed, sized and fabricated to receive rainwater flow without spillover and redirect rainwater from the roof, to the gutters, and from the gutters to the downspouts and into the storm water management system. Gutters shall be sized and have sufficient thickness and attachment to structure so that they do not sag, dent, deform, bend or exhibit other deficiencies during service life.
- .6 Isolation coating: alkali-resistant bituminous paint or aerosol.
- .7 Plastic cement: to ASTM D4586 / D4586M.
- .8 Slip-sheet: reinforced sisal paper or a heavy felt kraft paper.
- .9 Joint sealant/caulking: as recommended by the roofing manufacturer as compatible with the materials included in the roof assembly; to Section 07 92 00.
- .10 Cold-applied rubber asphalt joint sealing compound: #158 Cold-Applied Rubberized-Asphalt Sealer, by W. R. Meadows., or similar to same effect, with same or better physical properties and performance characteristics.
- .11 Fasteners: concealed, aluminum zinc alloy coated, suitable for structural deck material.
- .12 Washers: of same material as sheet metal, 1 mm thick with rubber packing.
- .13 Sheet metal flashing, curbs, and trim: prefinished flashing materials to match roofing materials, except 0.8 mm minimum base metal thickness.
- .14 Penetration flashing: pre-manufactured silicone flashings as required, and able to withstand constant temperatures at the roofline of -50°C (-58°F) to 200°C (392°F) and up to 250°C (482°F) intermittently.
  - .1 Acceptable Materials:
    - .1 Dektite (red silicone flashing), by DEKS Industries Pty Ltd., or similar to same effect, with same or better physical properties and performance characteristics.
- .15 Touch-up paint: Field cuts and any holes cut to be treated with a zinc-rich coating of a type recommended by the roofing manufacturer, includes colour touch-ups to blend in with adjacent colour as closely as possible; touch-up paint to be as supplied by the roofing manufacturer.

## **2.10 SNOW RETENTION SYSTEM**

- .1 Location: as indicated.
- .2 Provide Snow Guards: continuous metal pipe type recommended by sheet metal roofing manufacturer and meeting warranty conditions, fabricated of non-corrosive prefinished metal. Installed without penetrating metal roofing system, and complete with predrilled holes, clamps, or hooks for anchoring.

## **2.11 FINISHES**

- .1 Hot dipped galvanizing, to ASTM A653/A653M, coating designation Z275.



- .2 Exterior Coil Coating System: Supplier's premium PVDF factory-applied powder coating system, to AAMA 2604; colours as selected by Consultant from manufacturer's full range.
- .3 Interior: SMP silicone-modified polyester factory-applied coating system; colours as selected by Consultant from manufacturer's full range.

## **2.12 FABRICATION**

- .1 Fabricate all components of the system in the factory, ready for field installation.
- .2 Provide roof panels and all accessories in longest practicable length to minimize field lapping of joints.
- .3 Fabricate metal roofing panels square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .4 Fabricate to accommodate thermal expansion and contraction without distortion or oil canning, and capable of resisting wind uplift forces.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Comply with Warranty and MBMA Metal Roofing Systems Design Manual guidelines requirements and recommendations.
- .2 Meet or exceed OBC requirements and applicable CSSBI standards and guides.
- .3 All installation work shall be carried out by trained erection crews in accordance with the manufacturer's instructions and these Specifications.

### **3.2 COORDINATION**

- .1 Cooperate and coordinate with other trades as required to ensure continuity of waterproofing, vapour retarder and air barrier systems.

### **3.3 EXAMINATION**

- .1 Examine roof structure and substructure to confirm that they are within the tolerances required by metal roofing system manufacturer.
- .2 Examine and obtain all necessary measurements of previously executed work which may affect the work of this Section.
- .3 Proceeding with the work means acceptance of as-found conditions.

### **3.4 LINER PANELS**

- .1 Install liner panels coordinated with installation of thermal blocks to provide a thermal break between panels and purlins and other steel elements that might conduct thermal conditions from the exterior to the interior and vice versa. Install liner panels properly secured to structure as per reviewed engineered Shop Drawings.
- .2 Caulk and seal all seams, joints, holes, gaps and penetrations as required to ensure continuity of vapour control layer performance.

### **3.5 INSULATION**

- .1 Install insulation to thicknesses and in layers as noted on Drawings. Coordinate with installation of thermal clip system. Wherever necessary, fill all voids in the roof insulation application, such as cut-outs around roof projections, to maintain the continuity of the thermal control layers.

**3.6 THERMAL BLOCKS**

- .1 Install thermal blocks at top and bottom of purlins as noted on Drawings and as per reviewed engineered Shop Drawings.

**3.7 FASCIA, TRIM, CLOSURES AND FLASHINGS**

- .1 Form and profile fascia and trim including inside and outside corners, flashing, edgings, cap strips, drips, fillers, closure strips, and starter strips.
- .2 Cut neat holes in metal roofing to accommodate roof penetrations and install penetration flashing for a watertight installation.

**3.8 STANDING SEAM ROOFING**

- .1 Supply and install complete roofing system as per Drawings and reviewed engineered Shop Drawings.
- .2 Sheet steel roof cladding shall be installed in the longest lengths possible and shall be adjusted to final position before being permanently fastened to structure.
- .3 Install cleats spaced at 300 mm o.c. minimum. Secure cleats with two fasteners each minimum, structural deck below.
- .4 Fold lower end of each panel 19 mm to underside, and upper end of each panel 50 mm onto topside. Slit fold 25 mm away from corner to form tab where panel turns up to make standing seam. Interlock lower and upper ends of panels.
- .5 Apply sheet metal roofing beginning at eaves. Loose lock pans to valley flashing and edge strips at eaves and gable rakes.
- .6 Double Fold Seams: Install standing seams 25 mm high on flat surfaces. Bend up one side edge 40 mm and other 45 mm. Make first fold 6 mm wide single fold and second fold 13 mm wide, to form locked portion of standing seam with 5 plies in thickness. Fold lower ends of seams at eaves over at 45° angle. Terminate standing seams at vented ridge and hips by turning down in tapered fold.
- .7 Install metal roofing panels in one piece, for entire slope, except as indicated otherwise.
- .8 Install fascia and soffits as per Drawings and reviewed engineered Shop Drawings.
- .9 Install gutters and downspouts as per Drawings and reviewed engineered Shop Drawings.
- .10 Remove and replace damaged metal roofing; do not touch-up damaged panels – replace them.
- .11 Use concealed fasteners.
- .12 Apply isolation coating to metal surfaces in contact with concrete or mortar.
- .13 Install snow guard system as specified by manufacturer, and in compliance with the sheet metal roofing manufacturer's warranty conditions.
- .14 Coordinate and cooperate with mechanical trades as required to ensure proper integration of mechanical vents and connections to structure.

**3.9 JOINT SEALANTS**

- .1 Seal as necessary to form weather tight and watertight seal between flashing and adjoining surfaces and between flashing and other work. Sealing work consists of bedding between members where possible. Tool sealant to concave profile where exposed.

**3.10 WARRANTY INSPECTIONS**

- .1 Pre-engineered metal building supplier shall issue roof warranty made out to Owner's name.

**3.11 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.12 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.13 SCHEDULE**

- .1 Install as indicated on design Drawings, and pre-engineered metal building supplier's reviewed engineered Shop Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 04 22 00 - Unit Masonry.
- .2 Section 06 10 00 - Rough Carpentry.
- .3 Section 07 92 00 - Joint Sealants.
- .4 Section 07 42 42 - Aluminum Composite Panels.
- .5 Section 07 46 19 - Preformed Metal Cladding.
- .6 Section 07 61 13 - Standing Seam Sheet Metal Roofing.
- .7 Section 08 44 13 - Glazed Aluminum Framing Systems.
- .8 Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI H35.1/H35.1M-2017, American National Standard Alloy And Temper Designation Systems For Aluminum.
- .2 ASTM International (ASTM)
  - .1 ASTM A240/A240M-24b, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .2 ASTM A606/A606M-23, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
  - .3 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A792/A792M-23, Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .5 ASTM B32-20, Standard Specification for Solder Metal.
  - .6 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .7 ASTM D4586/D4586M-07(2024), Standard Specification for Asphalt Roof Cement, Asbestos-Free.
  - .8 ASTM F1667/F1667M-21a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .3 Canadian Roofing Contractors Association (CRCA)
  - .1 CRCA Roofing Specifications Manual (most recent published edition).
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA Architectural Sheet Metal Manual, 2012, 7th Edition.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures:

- .1 Submit manufacturer's published product literature, specifications and datasheets for all products and materials incorporated into the Work of Contract.
- .2 Verification Samples:
  - .1 Submit duplicate 300 x 300 mm samples of each type of sheet metal material, colour and finish proposed to be used for the project and obtain written acceptance from Consultant before ordering materials.
- .3 Submit representative sample section of pre-painted metal flashing illustrating S-locking jointing method, minimum 600 mm long.
- .4 Submit warranty.

#### **1.4 QUALITY CONTROL**

- .1 General: Fabricate and install sheet metal flashing and trim in accordance with SMACNA Architectural Sheet Aluminum Manual, and to the CRCA Roofing Specifications Manual.
- .2 Sheet Metal and Metal Flashing: Comply with the applicable recommendations and guidelines of the CRCA Canadian Roofing Reference Manual, CRCA Specification Manual, and applicable CRCA technical bulletins.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Stack pre-formed and pre-finished material in manner to prevent twisting bending and rubbing.
- .2 Provide protection for finished surfaces.
- .3 Prevent contact of dissimilar metals during storage and protect from acids, flux, and other corrosive materials and elements
- .4 Protect prefinished surfaces from scratches and from rust staining.

#### **1.6 WARRANTY**

- .1 Contractor agrees to correct any deficiencies of labour or material found in the work performed for a period of 5 years from the date of Substantial Performance.
- .2 Provide Warranty for sheet metal flashing and trim to include in maintenance manuals.

### **Part 2 Products**

#### **2.1 FLASHING MATERIALS**

- .1 Formed steel flashings: hot dip galvanized steel sheet (factory pre-finished): commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.
  - .1 Class: F1S-Finished one side (manufacturer's standard prime finish on unexposed face).
  - .2 Coating system: Manufacturer's silicone modified polyester (SMP) system, applied over a zinc phosphate pre-treatment, and high-performance, flexible primer.
    - .1 Standard of Acceptance:
      - .1 Perspectra Series, by ArcelorMittal, or WeatherX, by Valspar.
  - .3 Colours: as selected by Consultant from manufacturer's full range to match exposed surface of adjacent assembly into which flashing is to be integrated.

- .2 Formed aluminum flashings: Tension-levelled, commercial quality aluminum sheet in accordance with ASTM B209/B209M; use ANSI H35.1 aluminum alloy designation 3003-H14 for general use,
  - .1 Minimum Thicknesses:
    - .1 General Applications where indicated: minimum 0.81 mm thick.
    - .2 Copings: 1.6 mm thick solid prefinished aluminum, formed to profile required.
  - .2 Finish: factory applied silicone modified polyester (SMP); colour as selected by Consultant from manufacturer's full range to match adjacent construction.
  - .3 Unexposed aluminum: Mill finish.
- .3 Form flashings, copings, and fascia to profiles indicated or as required to achieve the design intent illustrated by the Drawings.
- .4 Soffits and Fascia at Roof Types R-2 and R-3: to Section 07 42 42 - Aluminum Composite Panels.
- .5 Soffits and Fascia at Roof Type R-1: to Section 07 61 13 - Standing Seam Sheet Metal Roofing.
- .6 Gutters, downspouts and connections to storm water management system, snow guards: refer to Section 07 61 13 Standing Seam Metal Roof.

## **2.2 ACCESSORIES**

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Roofing Cement: to ASTM D4586/D4586M, asphalt-based, asbestos free.
- .3 Underlay for metal flashings exposed to direct sunlight: adhered SBS-modified bituminous membrane for high temperature applications; rubberized asphalt will not flow up to temperatures as high as 127°C; primer as supplied by system manufacturer.
  - .1 Standard of Acceptance:
    - .1 Grace Vycor™ Ice & Water Shield® HT, or approved equivalent
- .4 Sealants: as indicated in Section 07 92 00 – Joint Sealants.
  - .1 Mastic Sealant: polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.
  - .2 Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00.
- .5 Prefinished Steel Accessories: Provide non-corrosive sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work. Accessories shall match or be compatible with material being installed; size and thickness as required.
- .6 Touch-up paint: as recommended by prefinished material manufacturer. Exterior grade plywood backing and wood blocking: to Section 06 10 00 – Rough Carpentry.

## **2.3 SLEEVE FLASHING SYSTEMS**

- .1 Sleeve flashing systems: by electrical and mechanical trades, and suited to sloped sheet metal roofing.

## **2.4 FABRICATION**

- .1 Roofing: Fabricate flashing and other sheet metal work in accordance with applicable CRCA 'FL' series details, and as indicated.

- .2 Galvanized sheet steel: Fabricate in accordance with SMACNA Architectural Sheet Metal Manual.
- .3 Form sections square, true, and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .4 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- .5 Make flashings of prefinished metal for cap flashings as specified above for flashings adjacent to roofing at roof edges and area dividers, and where exposed to view from ground or an interior public area.
- .6 Make flashings for other locations of hot dip galvanized metal, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating, as follows:
  - .1 Use 0.61 mm metal core thickness except where otherwise specified.
  - .2 Use 0.84 mm metal core thickness for concealed fastening strips.
  - .3 Use material of thickness specified for other applications, and as indicated.
- .7 All straight run joints shall be S-Lock in roof flashings.
- .8 Make joints to allow for thermal movement, space S-Lock joints at 3000 mm maximum centers.
- .9 Make flashings for building into masonry and concrete so that joints can be lapped 100 mm or more.
- .10 Strengthen free edges of metal flashings by folding to form a 13-mm hem.
- .11 Make flashings to curbs, walls, and parapets a minimum of 100 mm high, where possible.
- .12 Provide premanufactured flashing sleeves and collars for all piers, pipes and conduit extending through the roof, meeting roofing manufacturer's warranty requirements.
- .13 Make joints for corners and intersections with standing seams except where exposed of pre-finished metal when seams shall be flat locked.
- .14 All bends machine made. Form sections square, true, and accurate to size, free from distortion and other defects detrimental to appearance or performance.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Check mounting and counterflashing of mechanical items and report any defect to the Consultant.
- .2 Verify that solid wood blocking or sheathing provided to back-up all flashings and that all nails, screws set and wood provides a smooth flat plane.
- .3 Verify that all reglets, provided under other Sections or built-in by other trades, properly and securely located, true and level in line.
- .4 Commencement of Work means acceptance of existing conditions.

#### **3.2 INSTALLATION**

- .1 Install sheet metal flashing and trim in accordance with applicable CRCA 'FL' series details, SMACNA's Architectural Sheet Metal Manual, and as indicated.
- .2 Verify shapes and dimensions of surfaces being covered before fabricating sheet metal.

- .3 Do not install metal flashings over flexible roof flashing and expansion joints until the flexible roof flashing and expansion joints have been inspected and approved by the Consultant. This includes curbs for roof mounted items.
- .4 Where possible, secure flashings to supporting building elements with concealed continuous cleats or locking strips. Use hot dipped galvanized steel locking strips / cleats for prefinished steel flashing.
- .5 Do not use exposed fastening unless indicated, or concealed fastening is not possible. Locations and methods shall be acceptable to Consultant.
- .6 Anchor units of work securely in place, providing for thermal expansion of metal units. Conceal fasteners where possible and set units true to line and level.
- .7 Install work with laps, joints, and seams that are watertight and weatherproof.
- .8 Install exposed sheet metal work that is without oil canning, buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weatherproof performance.
- .9 Install surface mounted reglets true and level, and caulk top of reglet with sealant. Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .10 Where flashing is installed around circular components and upper flashing jack is exposed, provide draw-band and around upper edge and seal top flange.
- .11 Insert metal flashing into reglets or under cap flashing as indicated to form weather tight junction.
- .12 Fasten metal base flashing to walls or upstands along top of flashing. Do not secure to cant strips. Form lapped corner joints. Extend rolled edge of base flashing approximately 25 mm on to roof from toe of cants, and rest on top of roof surface.
- .13 Roof Edge Flashing: Secure metal flashing at roof edges at a maximum of 610 mm o.c.
- .14 Expansion Provisions:
  - .1 Provide for the thermal expansion of exposed sheet metal Work.
  - .2 Space movement joints at maximum of 3050 mm, with no joints allowed within 610 mm of a corner or intersection, or as otherwise indicated per Drawings.
  - .3 Form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with mastic sealant (concealed within joints) where lapped or bayonet type expansion provisions in the work cannot be used or are not sufficiently weatherproof and waterproof.
  - .4 Provide slip joints to allow for movement.
- .15 Sealed Joints:
  - .1 Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant.
  - .2 Fill joint with sealant and form metal to conceal sealant completely.
  - .3 Use joint adhesive for non-moving joints specified.
- .16 Lock Seams:
  - .1 Fabricate non-moving seams in sheet metal with flat lock seams.
- .17 Separations:



- .1 Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with bituminous paint or other permanent separation as recommended by the manufacturer.
- .2 Underlayment: Install a slip-sheet of No. 15 perforated asphalt saturated felt and a course of polyethylene underlayment where installing sheet metal directly on cementitious or wood substrates. Secure in place and lap joints minimum 100 mm.
- .3 Bed flanges of work in a thick coat of roofing cement where required for waterproof performance.
- .18 Counter Flashing:
  - .1 Coordinate installation of counter flashing with installation of assemblies being protected by counter flashing.
  - .2 Secure in a waterproof manner.
  - .3 Lap counter flashing joints a minimum of 50 mm and bed with sealant.
- .19 Flashing and metal closures: where flashing and metal closures overlap at any point in a system, ensure that flashing and closures are shingled over top lower sheet(s) and not behind, so that water is directed, and drains, to the exterior.
- .20 Roof Drainage System:
  - .1 Install drainage items fabricated from sheet metal, with straps, adhesives and anchors as required, to drain the roof in the most efficient manner.
  - .2 Coordinate roof drain flashing installation with roof drainage system installation.
  - .3 Provide internal drainage piping from roof drains as required; refer to mechanical design Drawings; coordinate with mechanical trades as required.
- .21 Equipment Support Flashing:
  - .1 Coordinate equipment support flashing installation with roofing and equipment installation.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.4 PROTECTION**

- .4 Protect installed products and components from damage during construction.
- .5 Repair damage to adjacent materials caused by Work of this Section.

### **3.5 SCHEDULE**

- .1 Install as required and as per Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 This Section includes firestopping and smoke seal systems for penetrations through fire resistance rated assemblies, including both empty openings and openings containing penetrating items.
- .2 Coordinate with electrical and mechanical Subcontractors as required to determine number, sizes, and types of penetrations to be addressed under this specification section.
- .3 This Section includes fire resistive joint systems.
- .4 This specification section provides requirements for Rated Systems or systems requiring Engineered Judgements:
  - .1 Use of materials that have not been tested in a system or that are not capable of obtaining an engineered judgement will not be acceptable for use on this Project.
  - .2 Materials having only a ULC label will not be acceptable for use on this Project, unless supporting documentation is provided indicating its use in a listed assembly.

**1.2 RELATED REQUIREMENTS**

- .1 Division 03 cast in place concrete.
- .2 Section 04 22 00 - Unit Masonry.
- .3 Section 09 21 16 - Gypsum Board Assemblies.

**1.3 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A1008/A1008M-24, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
  - .3 ASTM E119-24, Standard Test Methods for Fire Tests of Building Construction and Materials.
  - .4 ASTM E1966-15, Standard Test Method for Fire-Resistive Joint Systems.
  - .5 ASTM E2174-20a, Standard Practice for On-Site Inspection of Installed Fire Stops.
  - .6 ASTM E2307-23b, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus
  - .7 ASTM E2393-20a, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- .2 Firestop Contractors International Association (FCIA)
  - .1 FCIA Firestop Manual of Practice - 8th Edition (MOP).
  - .2 FM 4991, Standard for the Approval of Firestop Contractors, 2013.
- .3 International Firestop Council (IFC)
  - .1 Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs).

- .4 International Code Council (ICC) / International Building Code (IBC)
  - .1 2021 IBC, Chapter 7.
- .5 ULC Standards
  - .1 ULC Guide No. 40 U19, Firestop Systems; ULC Category Code Number XHEZC.
  - .2 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .3 CAN/ULC S102-18, Standard Method of Tests for Surface Burning Characteristics of Building Materials and Assemblies.
  - .4 CAN/ULC S114:2018, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .5 CAN/ULC S115:23, Standard Method of Fire Tests of Fire stop Systems.
  - .6 CAN/ULC S702.1:21, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .7 CAN/ULC S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
- .6 Underwriters Laboratories Inc. (UL)
  - .1 UL 1479, Standard for Fire Test of Through-Penetration Firestops, 2015.

#### **1.4 REGULATORY REQUIREMENTS**

- .1 Work of this Section shall meet or exceed the requirements of the Ontario Building Code as amended (OBC).

#### **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Consultant in accordance with Section 01 32 16 – Construction Schedule to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building trades.
  - .4 Coordinate with authorities having jurisdiction as required to determine submissions required and the acceptability of firestop and smoke seal installations planned for the facility.
  - .5 Review manufacturer's installation instructions, and warranty requirements.

#### **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit Shop Drawings:
  - .1 Submit Shop Drawings illustrating fire stopping details and product data related to each condition within the building that requires fire stopping or smoke seal treatment under the provisions of this Section.
- .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

- .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics and CAN-ULC S115.
  - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
  - .2 Document from Engineer of Record showing compliance of alternative fire stopping solution with CAN-ULC S115 and the EJ guidelines provided by the National Research Council, *Best Practices Guide on Fire Stops and Fire Blocks and Their Impact on Sound Transmission*.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
- .4 Manufacturer's Field Reports: submit to manufacturer's written reports within three days of review, verifying compliance of Work, as described in PART THREE - FIELD QUALITY CONTROL.

#### 1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: Use materials and methods of determining required thickness of application that have the full acceptance of Authority Having Jurisdiction and that are tested in accordance with ULC S115, and that form a part of a ULC or CUL listed system, Engineered Judgement or Equivalent Fire Resistance Rated Assembly.
- .2 Use materials and methods of determining required thickness of application that have the full acceptance of authority having jurisdiction.
- .3 Qualifications: Installer: company or person specializing in fire stopping installations and approved by manufacturer with five years documented experience
- .4 Where possible determine thickness to be applied from tests of assemblies identical to the assembly to be protected, conducted in accordance with ULC S-101, ASTM E119, ULI 1479, NFPA 251, and ASTM E814.
- .5 Determine system from available engineering studies, or correspondence with the labelling agency indicating the effect of the differences on the fire separation of the assembly. Confirm acceptance of system by authorities having jurisdiction in writing.
- .6 Where the assembly includes conditions that do not correspond to those included in any previously tested assembly and for which no relevant engineering information is available use the same system and material as would be required for a tested assembly with similar conditions and that will achieve at least the minimum level of performance required in a previously tested assembly.
- .7 Use materials tested to CAN/ULC S115. Assemblies containing the materials shall be in accordance with assemblies tested and approved by agencies acceptable to authority having jurisdiction.
- .8 Source Responsibility: Obtain through penetration firestop and joint systems, for each kind of penetration and construction condition indicated, from a single source of installation responsibility.
- .9 Delegated Design Professional: Use a Professional Engineer, registered in the province of the Work and familiar with installations of similar scope and complexity to design firestopping and smoke seals.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling, and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC markings.
- .2 Storage and Protection:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.
  - .3 Use stock before its expiration date.

## **1.9 PROJECT CONDITIONS**

- .1 Install firestopping and smoke seals materials only when areas in which they are scheduled are closed-in and protected from dampness.
- .2 Environmental Limitations: Install firestopping and smoke seals systems when ambient or substrate temperatures are within temperature and moisture limits permitted by firestopping and smoke seals system manufacturers or when substrates are not wet due to rain, frost, condensation, or other causes.
- .3 Ventilate firestopping and smoke seals systems in accordance with manufacturer's written instructions by natural means or forced air circulation where natural means are not adequate.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Subject to compliance with requirements specified in this Section and as established by the Standard of Acceptance Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
  - .1 3M Canada Inc.
  - .2 A/D Fire Protection Systems Inc.
  - .3 Firestop Systems Inc.
  - .4 Hilti Canada Ltd.
  - .5 Nuco Self Seal Firestopping Products.
  - .6 Owens Corning.
  - .7 Specified Technologies Inc.
  - .8 Tremco Ltd.

### **2.2 PERFORMANCE AND DESIGN CRITERIA**

- .1 Delegated Design Requirements: Design firestopping and smoke seals required by the Contract Documents to meet fire ratings indicated, and in accordance with requirements of the OBC and amendments.
- .2 Performance Requirements: Manufacturer shall design proprietary assemblies to withstand the listed ratings in accordance with the OBC, Underwriters Laboratories Canada, and authorities having jurisdiction, and as follows:

- .1 Provide through-penetration firestop and joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire resistance rating of assembly penetrated:
  - .1 Fire resistance rated load bearing walls, including partitions, with fire protection rated openings.
  - .2 Fire resistance rated non-load bearing walls, including partitions, with fire protection rated openings.
  - .3 Fire resistance rated floor assemblies.
- .2 F-Rated Systems: Provide through penetration firestop systems with F-ratings indicated, as determined by CAN/ULC S115, but not less than that equalling or exceeding fire resistance rating of constructions penetrated.
- .3 T-Rated Systems: For the following conditions, provide through penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per by CAN/ULC S115, where systems protect penetrating items exposed to potential contact with adjacent materials:
  - .1 Penetrations located outside wall cavities.
  - .2 Penetrations located outside fire resistive shaft enclosures.
  - .3 Penetrations located in construction containing fire protection rated openings.
  - .4 Penetrating items larger than 100 mm diameter nominal pipe or 100 cm<sup>2</sup> in overall cross-sectional area.
- .4 Firestopping and Smoke seals Systems Exposed to View: Systems exposed to view, traffic, moisture, and physical damage; provide products that after curing do not deteriorate when exposed to these conditions both during and after construction, and as follows:
  - .1 Provide moisture resistant through penetration firestop systems for piping penetrations for plumbing and wet pipe sprinkler systems.
  - .2 Provide firestopping and smoke seals systems capable of supporting floor loads involved either by installing floor plates or by other means for floor penetrations with annular spaces exceeding 100 mm in width and exposed to possible loading and traffic.
  - .3 Provide firestopping and smoke seals systems not requiring removal of insulation for penetrations involving insulated piping.
  - .4 Provide products with flame spread ratings of less than 25 and smoke developed ratings of less than 50 for firestopping and smoke seals and joint systems exposed to view.
- .5 Fire Resistance of Joint Systems: Assembly ratings and movement capabilities indicated, but with assembly ratings not less than that equalling or exceeding fire resistance rating of constructions in which joints are located.

## 2.3

### FIRESTOPPING AND SMOKE SEALS: GENERAL

- .1 Compatibility: Provide firestopping and smoke seals systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating firestopping and smoke seals systems, under conditions of service and application, as demonstrated by firestopping and smoke seals system manufacturer based on testing and field experience, and as follows:
  - .1 Service penetration assemblies: certified by ULC in accordance with CAN/ULC S115 and listed in ULC Guide No. 40 U19.

- .2 Service penetration firestopping and smoke seals components: certified by ULC in accordance with CAN/ULC S115 and listed in ULC Guide No. 40 U19.13, under the Label Service of ULC.
- .3 Fire resistance rating of installed firestopping and smoke seals assembly not less than the fire resistance rating of surrounding floor and wall assembly.
- .4 Firestopping and Smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.
- .5 Firestopping and Smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations. Exemption to fire dampers.
- .2 Accessories: Provide components for each firestopping and smoke seals systems that are needed to install fill materials. Use only components specified by firestopping and smoke seals system manufacturer and approved by the qualified testing and inspecting agency for firestopping and smoke seals systems indicated. Accessories include, but are not limited to, the following items:
  - .1 Permanent forming, damming and backing materials, including the following:
    - .1 Slag or rock wool fibre insulation.
    - .2 Sealants used in combination with other forming, damming or backing materials to prevent leakage of fill materials in liquid state.
    - .3 Fire-rated form board.
    - .4 Fillers for sealants.
  - .2 Temporary forming materials.
  - .3 Substrate primers.
  - .4 Collars.
  - .5 Steel sleeves.
  - .6 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
  - .7 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
  - .8 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m<sup>2</sup>, minimum metal core thickness 0.912 mm.
  - .9 Steel Deck Moulded Flute Inserts: One piece moulded mineral fibre flute inserts, sized for steel deck profiles, for placement at top of fire rated wall assemblies:
    - .1 Acceptable material: Hilti CP777 Speed Plugs.
  - .10 Labels: Peel-and-stick labels printed with the following information:
    - .1 ATTENTION: FIRE RATED ASSEMBLY. DO NOT MODIFY
    - .2 Name of firestopping manufacturer
    - .3 Names of products used
    - .4 Hour Rating of Assembly
    - .5 Manufacturers standard detail number, or Engineered Judgement identifier; ULC or cUL<sub>US</sub> Number
    - .6 Date of installation
    - .7 Name of installing Trade Contractor
    - .8 Contact telephone number for repair or replacement of firestopping materials.

- .1 General:
  - .1 Provide firestopping and smoke seals systems containing the types of fill materials indicated in the Firestopping and Smoke Seals System Schedule below by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
  - .2 Firestopping and smoke seal systems shall be tested in accordance with CAN/ULC S115, and be comprised of asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases, and not to exceed opening sizes for which they are intended for the ratings as indicated on drawings.
- .2 Mineral wool materials as required to fill larger voids, meeting ULC and OBC firestop design requirements.
- .3 Cast-in-Place Firestopping and Smoke seals Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- .4 Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- .5 Firestopping and Smoke Seals Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrating item.
- .6 Cable Penetration Devices: premanufactured fire rated cable pathway systems, the following products are acceptable:
  - .1 EZ-Path Fire Rated Pathway, Specified Technologies Inc.
  - .2 CP 653 Speed Sleeve, Hilti
- .7 Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced elastomeric sheet bonded to galvanized steel sheet.
- .8 Intumescent Putties: Non-hardening dielectric, water resistant putties containing no solvents, inorganic fibres, or silicone compounds.
- .9 Intumescent Spray Foam: Expanding spray-in-place intumescent foam sealant.
- .10 Intumescent Wrap Strips: Single component intumescent elastomeric sheets with aluminum foil on one side.
- .11 Mortars: Pre-packaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- .12 Silicone Foams: Multi-component, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- .13 Silicone Sealants: Moisture curing, single component, silicone based, neutral curing elastomeric sealants of grade indicated below:
  - .1 Grade for Horizontal Surfaces: Pourable (self-levelling) formulation for openings in floors and other horizontal surfaces.
  - .2 Grade for Vertical Surfaces: non-sag formulation for openings in vertical and other surfaces.

## 2.5 ACCESSORIES

- .1 Primers: to manufacturer's recommendation for specific material, substrate, and end use.



- .2 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .3 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .4 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m<sup>2</sup>, minimum metal core thickness 0.95 mm (20 ga.).

## **2.6 MIXING**

- .1 For those products requiring mixing before application, comply with firestopping and smoke seals system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
  - .1 Ensure that substrates and surfaces are clean, dry and frost free.
  - .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
  - .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to air vapour barrier.
  - .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's printed installation instructions, technical datasheets, details, and specifications.

### **3.3 PREPARATION**

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
- .2 Ensure that substrates and surfaces are clean, dry and frost free.
- .3 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .4 Maintain insulation around pipes and ducts penetrating fire separation without interruption to air vapour barrier.
- .5 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

### **3.4 INSTALLATION**

- .1 Apply and install fire stopping materials to correspond with tested assemblies, or calculation procedures acceptable to authorities having jurisdiction to provide following fire resistance ratings:

- .1 Floor assemblies shall be fire separations with a fire-resistance rating of not less than 2 hours.
- .2 Mezzanines shall have a fire-resistance rating not less than 1 hour.
- .3 Loadbearing walls, columns and arches shall have a fire-resistance rating not less than that required for the supported assembly.
- .4 Other fire ratings as indicated on Drawings and OBC Compliance Report.
- .2 Install firestopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .3 Provide firestopping assemblies at joints and penetrations of fire resistance rated assemblies as required to achieve and maintain minimum Sound Transmission Class (STC) of 60.
- .4 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .5 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .6 Tool or trowel exposed surfaces to neat finish.
- .7 Remove excess compound promptly as work progresses and upon completion.
- .8 At electrical boxes installed at gypsum board fire separations, Provide firestop back-coating on box.

### **3.5 SPECIAL REQUIREMENTS**

- .1 Location of special requirements for fire stopping and smoke seal materials at openings and penetrations in fire resistant rated assemblies are as follows:
  - .1 Designed for re-entry, removable at: electrical and communications cable penetrations through partitions.
    - .1 Use Prefabricated Firestop Sleeves or prefabricated Cable Pathways.

### **3.6 SEQUENCING**

- .1 Proceed with installation only when submittals have been reviewed by Consultant.
- .2 Install mechanical and electrical services prior to firestopping. Firestopping shall not be installed at these locations until the electrical and mechanical installations have been reviewed and accepted by Consultant.
- .3 Install floor firestopping before interior partition erections.
- .4 Metal deck bonding: firestopping to precede spray applied fireproofing to ensure required bonding.
- .5 Mechanical pipe insulation: certified firestop system component.
  - .1 Ensure pipe insulation installation precedes firestopping.

### **3.7 FIELD QUALITY CONTROL**

- .1 Review: notify Consultant when ready for review and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
  - .1 Cut tests may be made at random by the Owner. Frequency of cut tests shall be determined by the Consultant, but will not be more than 1% of total length of firestopping and smoke seals.

- .2 Make all necessary repairs and correct all deficiencies noted after completion of cut tests.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART ONE - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, twice during progress of Work at 25% and 60% complete.

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.9 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.10 SCHEDULE**

- .1 Fire stop and smoke seal at the following:
  - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
  - .2 Edge of floor slabs at curtain wall.
  - .3 Top of fire-resistance rated masonry and gypsum board partitions.
  - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
  - .6 Penetrations through fire-resistance rated floor slabs, ceilings, and roofs.
  - .7 Openings and sleeves installed for future use through fire separations.
  - .8 Around mechanical and electrical assemblies penetrating fire separations.
  - .9 Rigid ducts: greater than 129 cm<sup>2</sup>: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
  - .10 Between floor slabs and perimeter walls.
  - .11 At gaps between edge of floor slabs and gypsum board at perimeter walls.
  - .12 At gap between vertical curtain wall and window mullions and gypsum board assemblies.
  - .13 Other locations shown on Drawings and as required to achieve and maintain required fire separations as per OBC requirements.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C834-17(2023), Standard Specification for Latex Sealants.
  - .2 ASTM C919-24, Standard Practice for Use of Sealants in Acoustical Applications.
  - .3 ASTM C920-18(2024), Standard Specification for Elastomeric Joint Sealants.
  - .4 ASTM C1193-25, Standard Guide for Use of Joint Sealants.
  - .5 ASTM D2240-15(2021), Standard Test Methods for Rubber Property, Durometer Hardness.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).

**1.2 COORDINATION**

- .1 Coordinate work of this Section with interfacing and adjoining work for proper sequencing of each installation and to provide positive weather resistance, durability of the work, and protection of materials and finishes.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals shall comply with the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Submit manufacturer's product data as follows:
  - .1 Submit manufacturer's published product literature, specifications and datasheets for all products and materials incorporated into the Work of Contract.
  - .2 Provide one electronic copy of WHMIS SDS - Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.
- .3 Submit manufacturer's installation instructions for each product used.
  - .1 Before performing work of this Section, submit the names of proposed materials.
  - .2 When required by Consultant, submit test certificates from an approved Canadian material testing laboratory indicating that sealants meet the requirements specified, and that the tests have been conducted in accordance with ASTM D2240.
- .4 Submit samples as follows:
  - .1 Samples of back-up material, primer, joint fillers, and of each type and colour of sealant to be used. Cure samples under conditions anticipated at the site during application.
- .5 Reports: submit written pre-installation meeting recommendations, field inspection, and test report results after each inspection.
- .6 Submit Warranty.

#### **1.4 QUALITY ASSURANCE**

- .1 Comply with ASTM C1193 guidelines.
- .2 Pre-Installation Meeting:
  - .1 Arrange with manufacturer's representative to inspect substrates and to review installation procedures 48-hours in advance of installation.
    - .1 Review conditions under which work will be done.
    - .2 Joint condition and profile.
    - .3 Weather conditions.
  - .2 Submit written report of meeting to Consultant.
- .3 Mock-up:
  - .1 Construct mock-up in accordance with the requirements of Section 01 45 00.
  - .2 Construct mock-up to show location, size, shape, colour, and depth of joints complete with bond breaker, joint backing, primer, and sealant.
  - .3 Arrange for the manufacturer's representative's review and acceptance. Allow 48 hours after acceptance before proceeding with the work.
  - .4 Inform Consultant following construction of the mock-up. Allow 24 hours for review of mock-up by Consultant before proceeding with sealant Work.
  - .5 Mock-ups are subject to field adhesion testing, per item FIELD ADHESION TESTING.
  - .6 Mock-up may remain as part of the Work if accepted by Consultant. Remove and dispose of mock-ups not forming part of the Work.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, handle, store and protect materials in accordance with manufacturer's recommendations and instructions.
- .2 Deliver containers labelled and sealed, complete with written application and maintenance instructions.
- .3 Store materials in a dry, heated enclosure.

#### **1.6 PROJECT CONDITIONS**

- .1 Environmental Limitations:
  - .1 Do not proceed with installation of joint sealants under following conditions:
    - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
    - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
  - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
  - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.
  - .2 Substrate must be clean, dry, and frost free.

## **1.7 WARRANTY**

- .1 Contractor warrants that sealant work will not leak, crack, crumble, melt, shrink, run, lose adhesion or stain adjacent surfaces for not less than five (5) years from the date of Substantial Performance.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Standard of Acceptance: Use products meeting the requirements of this Section and suitable to the application to which the sealant is to be applied, selections restricted to the manufacturers listed below:
  - .1 BASF Master Builders
  - .2 Chemtron Manufacturing Ltd.
  - .3 Dow Corning Canada Inc.
  - .4 GE Silicones Limited.
  - .5 LymTal International.
  - .6 Pecora Corporation.
  - .7 PRC-DeSoto.
  - .8 Sika Chemical of Canada Ltd.
  - .9 Tremco Ltd.
- .2 Use materials as received from manufacturer without additives or adulteration. Use one manufacturer's product for each Type specified. Where sealant applications cross or contact each other, ensure compatibility, maintenance of physical properties and performance characteristics, and continuity of seal.

### **2.2 PERFORMANCE AND DESIGN REQUIREMENTS**

- .1 Sealant system shall satisfy following requirements for duration of warranty period:
  - .1 Waterproof, flexible, and thermally compatible with substrate under applicable service conditions.
  - .2 Provide a weather-tight seal that does not allow moisture penetration.
  - .3 Shall not lose adhesion to bonding surfaces, crack, or craze.
  - .4 Shall not leak.
- .2 Reference to products does not relieve manufacturer of responsibility to comply fully with specified criteria.

### **2.3 SEALANT MATERIALS**

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which off-gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off-gas time.
- .3 Avoid direct contact between polyurethane and silicone caulking; follow manufacturer's published procedures when polyurethane and silicone applications must intersect in the construction.
- .4 Refer to structural Drawings and Specifications for joint treatments at expansion, isolation and control joints.

- .5 This Section is for general applications; where a technical specification Section includes sealant/caulking specifications, those specifications shall take precedence over this Section.
- .6 Unless otherwise specified, VOC content limits of sealants shall be in accordance with SCAQMD Rule 1168 and as follows:
  - .1 Architectural Materials:
    - .1 Sealants: VOC content limit 250 g/L.
    - .2 Sealant Primers for Non-Porous Surfaces: VOC content limit 250 g/L.
    - .3 Sealant Primers for Porous Surfaces: VOC content limit 775 g/L.
  - .2 Roofing:
    - .1 Non-Membrane Related Sealants: VOC content limit 300 g/L.
    - .2 Single Ply Roofing Sealants: VOC content limit 450 g/L.
    - .3 SBS Membrane Sealant Primer: VOC content limit 500 g/L.
  - .3 All Other Applications:
    - .1 Sealants: VOC content limit 420 g/L.
    - .2 Sealant Primers: VOC content limit 750 g/L.

## 2.4 SEALANT MATERIAL DESIGNATIONS

- .1 Type S-1: Silicone Sealant; mould and mildew resistant.
  - .1 To ASTM C920; type S; grade NS; class 100/50; use NT, M, G, and A.
  - .2 Standard of Acceptance:
    - .1 790 Silicone, Dow Corning.
    - .2 Spectrem® 1 Silicone, Tremco Inc.
    - .3 890NST, Pecora.
- .2 Type S-2: Silicone Sealant; general construction and air-seal sealant.
  - .1 To ASTM C920: type S; grade NS; class 50; use NT, M, G, A, O.
  - .2 Standard of Acceptance:
    - .1 864NST or 895NST, Pecora Corporation.
    - .2 Dow Corning 795, Dow Corning
    - .3 Spectrem® 2, Tremco Sealant & Waterproofing
- .3 Type S-3: Silicone Sealant; structural glazing.
  - .1 To ASTM C920: type S; grade NS; class 25; use NT, A, G, O.
  - .2 Standard of Acceptance:
    - .1 995 Silicone, Dow Corning.
    - .2 Proglaze SSG, Tremco Inc.
    - .3 SSG4000, General Electric.
    - .4 895NST, Pecora.
- .4 Type S-4: Acoustical Sealant; interior, non-hardening.
  - .1 To ASTM C834 Type P, Grade -18°C.
  - .2 Standard of Acceptance:
    - .1 Acoustical Sealant, Tremco.
    - .2 Metaseal, Chemtron.
    - .3 QuietZone acoustic sealant, Owens Corning.



- .4 BA-98, Pecora.
- .5 Type S-5: not used.
- .6 Type S-5A: one-part, ultra-low-modulus, neutral-curing silicone elastomeric sealant for use in high-movement weather sealing applications. It has excellent primeless adhesion to concrete and most porous substrates and is available in a wide variety of colours.
  - .1 Locations: concrete and unit masonry substrates.
  - .2 To ASTM C920, Type S, Grade NS, minimum Class 100/50, Use NT, M, G, A, and O.
  - .3 Standard of Acceptance:
    - .1 Dowsil™ 790 Silicone Building Sealant, by The Dow Chemical Company.
    - .2 Sikasil®-728 NS, by Sika Canada.
    - .3 Approved equivalent.
- .7 Type S-6: Not Used.
- .8 Type S-7: Not Used
- .9 Type S-8: Not Used.
- .10 Type S-9: Not Used.
- .11 Type S-10: All exterior door thresholds, Showers, and other Wet Areas: two-component gun-grade, slump-resistant elastomeric polyurethane specially formulated for sealing joints in water-immersion conditions, and highly resistant to biodegradation by both aerobic and anaerobic bacteria; to Meets ASTM C920, Type M, Grade NS, Class 25, use T, NT, M, G, A, O; certified to CAN/ULC S115; Canadian Food Inspection Agency acceptance.
  - .1 Standard of Acceptance:
    - .1 Sikaflex 2c NS EZ Mix, by Sika Canada.
    - .2 Sikaflex 2c NS EZ Mix TG, by Sika Canada (traffic grade option).

## 2.5 ACCESSORIES

- .1 Preformed compressible and non-compressible back-up materials that are non-staining, compatible with joint substrate, sealants, primers, and other joint fillers, and are approved for applications indicated by sealant manufacturer based on site experience and laboratory testing.
  - .1 Rod Type Sealant Backings:
    - .1 ASTM C1330, Type C (closed cell material with a surface skin), or Type B (bi-cellular material with a surface skin).
    - .2 Use any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.
    - .3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
    - .4 Non-adhering to sealant, to maintain two-sided adhesion across joint.
  - .2 Extruded High Density Foam.
    - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m<sup>3</sup> density, or neoprene foam backer, size as recommended by manufacturer.
- .2 Preformed Sealants:

- .1 Preformed Silicone Sealant System: Manufacturer's standard system consisting of pre-cured low modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral curing silicone sealant for bonding extrusions to substrates:

- .1 Acceptable Materials:

- .1 DuPont; 123 Silicone Seal.
    - .2 GE Silicones; UltraSpan US1100.
    - .3 Tremco; Spectrem Ez Seal.

- .3 Primer: Non-staining type as recommended by sealant manufacturer.
- .4 Joint Cleaner: Non-corrosive solvent type recommended by sealant manufacturer for applicable substrate materials.
- .5 Bond Breaker: Pressure-sensitive plastic tape that will not bond to sealants.

## 2.6 COLOURS

- .1 Colours: to match adjacent materials as selected by Consultant from the manufacturer's available colour ranges.

## Part 3 Execution

### 3.1 PROTECTION

- .1 Protect installed work of other trades from staining, damage, or contamination.

### 3.2 EXAMINATION

- .1 Verify condition of previously installed work upon which this Section depends. Report defects to Consultant. Commencement of work means acceptance of existing conditions.
- .2 Ensure joints are suitable to accept and receive the sealants.
- .3 Ensure surfaces are sound, dry, and free from dirt, water, frost, loose scale, corrosion, bitumen, paints, and other contaminants that may adversely affect the performance of the sealing materials.
- .4 Do not apply sealant to masonry until mortar has cured.
- .5 Before any sealing work is commenced, test the materials for indications of staining or poor adhesion.
- .6 Ensure joints and spaces which are to receive sealants are less than 10 mm deep; not less than 6 mm wide; and not more than 19 mm wide.

### 3.3 SURFACE PREPARATION

- .1 Perform cleaning to the extent required to achieve acceptable joint surfaces, and as approved by sealant manufacturer.
- .2 Protect adjacent finishes from damage.
- .3 Cleaning Procedures:
  - .1 Metal:
    - .1 Blast cleaning: Sandblast or iron shot blast surfaces requiring heavy cleaning down to bright metal. Remove loose matter by compressed air or commercial vacuum cleaner.

- .2 Power tool cleaning: Clean surfaces by wire brush, impact tools, abrasive wheels or by buffing. Remove loose matter by compressed air or vacuum cleaner.
- .3 Solvent cleaning: Clean with solvent applied by spray or brush. Wipe with clean, dry wiping cloths. Remove paints with paint remover and wipe with solvent. Remove residue.
- .2 Concrete, Marble, Stone, Brick:
  - .1 Remove friable material with wire brush or by chipping, until surfaces are sound. Remove surface residue with a stiff brush, vacuum cleaner or compressed air.
  - .2 Concrete surfaces shall be cured for at least 28 days. Acid-etch joint surfaces to remove alkaline salts and neutralize acid with a solution of tri sodium phosphate, followed by rinsing with clean, cold water.
  - .3 Allow joints to dry thoroughly.
  - .4 Completely remove resinous products used, such as curing compounds and form release agents.
- .3 Glass, Ceramics, and Porcelain: Brush with solvent and wipe with clean, dry wiping cloths. Remove residue.
- .4 Wood: Remove foreign matter such as soil, paint, grease, bitumen, resin with solvents, abrasives and paint removers; remove residue. Provide surfaces that are clean and dry.
- .4 Do not exceed shelf life and pot life of the materials, and installation times, as stated by the manufacturers.
- .5 Be familiar with the work life of the sealant to be used. Do not mix multiple component materials until required for use.
- .6 Thoroughly mix multiple component sealants, and bulk sealants when recommended by manufacturer, using a mechanical mixer capable of mixing at 80-100 rpm without mixing air into the material. Continue mixing until the material is a uniform colour and free from streaks of unmixed material.
- .7 Mask areas adjacent to joints to be sealed. Prevent contamination of adjacent surfaces. Remove masking promptly after the joint sealing has been completed.

### 3.4 **INSTALLATION**

- .1 Install materials in compliance with the recommendations of their manufacturer.
- .2 Fill joints with joint backing to produce joint profile with optimum sealant cross section. Provide joint depth of one half the joint width.
- .3 Prime joints to receive sealants as recommended by the sealant manufacturer to prevent staining, to assist the bond and to stabilize pouring surfaces.
- .4 Apply primer with a brush that will permit joint surfaces to be primed. Perform priming immediately before installation of sealants, allowing minimal time between priming and sealing as recommended by the sealant manufacturer.
- .5 Sealants generally shall be of gun grade or knife grade non-sag consistency to suit the joint condition. Use gun nozzles of the proper sizes to suit the joints and the sealant material. Sealants for horizontal joints (other than overhead joints) shall be self-levelling type.
- .6 Install sealant with pressure operated guns.

- .7 Use sufficient pressure to fill all voids and joints solid. Sealant shall bond to the sides of the joint only and shall not adhere to the joint backing material. Provide bond breaker material where necessary.
- .8 Pour or gun self-levelling, low viscosity grades of sealant into horizontal joints. If applied by gun, hold the nozzle to the bottom of the joints to ensure complete filling of the joints.
- .9 Ensure that the correct sealant depth is maintained. Superficial coating with a skin bead will not be accepted.
- .10 Except as otherwise specified, sealant installations shall be a full bead free from air pockets and embedded impurities, providing smooth surfaces, free from ridges, wrinkles, sags, air pockets and imbedded impurities.
- .11 After joints have been completely filled, tool them neatly to a slightly concave surface.
- .12 Tool sealants to achieve airtight joints. Use wet tools as required. Use tooling agents and profiles approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces.
- .13 Insert plastic vent tubes where required or shown, extending from the cavity to exterior face, sloped to the exterior. Seal around the tube and tool for positive adhesion. Insert joint backing for remainder of the joint. Do not plug vent tube during sealing operation.

### **3.5 REPAIR**

- .1 Cut out damaged sealant, repeat preparation, prime joints, and install new material as specified, and acceptable to the manufacturer.

### **3.6 FIELD ADHESION TESTING**

- .1 Field test joint sealant adhesion to substrates in the presence of Consultant as follows:
  - .1 Extent of Testing: test completed and cured sealant joints as follows:
    - .1 Perform 10 tests for the first 300 m of joint length for each kind of sealant and joint substrate.
    - .2 Perform 1 test for each 300 m of joint thereafter or 1 test per each floor per elevation.
  - .2 Test Method: test joint sealants according to method A, Field-Applied Sealant Joint Hand Pull Tab, Appendix X1, ASTM C1193 or Method A, Tail Procedure, ASTM C1521.
    - .1 For joints with dissimilar substrates, verify adhesion to each substrate separately. Extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - .3 Inspect tested joints and report on finding for the following requirements:
    - .1 Joint cavities filled and free of voids.
    - .2 Sealant dimensions and configurations comply with sealant manufacturer's data sheet and printed installation requirements.
    - .3 No adhesive or cohesive failure noted during pull tests per ASTM criteria. Include data on pull distance used to test each kind of product and joint substrate.
  - .4 Record tests results in a field-adhesion test log. Include dates when sealants were installed, name of worker responsible in each instance, test dates, test locations, whether joints were primed or not, adhesion results and percent elongations, sealant fill, sealant configuration and dimensions.
  - .5 Repair sealant test locations by applying new sealants following approved preparation and application procedures.

- .2 Evaluation of Field Adhesion Test results:
  - .1 Sealants passing ASTM pull-tests and compliant with specifications will be considered satisfactory.
  - .2 Remove sealants that fail adhesion tests or do not meet specifications, and apply in accordance with approved preparation and application requirements.
  - .3 Retest re-applied sealants until test results are satisfactory and sealant application is compliant.

### **3.7 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
  - .2 Immediately clean adjacent surfaces that have been soiled and leave work in a neat, clean condition.
  - .3 Remove excess materials and droppings using recommended cleaners and solvents.
- .2 Final Cleaning:
  - .1 Upon completion remove surplus materials, rubbish, tools and equipment.
  - .2 Perform cleaning after installation to remove construction and accumulated dirt and debris.
- .3 Manage and properly dispose of construction waste materials in accordance with governing legislation and local by-laws.

### **3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.9 SCHEDULES AND GUIDELINES**

- .1 General Provisions:
  - .1 Examine the Contract Drawings and determine entire extent of Work of this Section. Seal joints at terminations, perimeters, transitions and penetrations.
  - .2 Where no specified type of sealant is shown or specified, choose one of the sealants specified in this Section appropriate for its location and conditions as recommended by the sealant manufacturer in accordance with its warranty provisions and datasheet. Confirm suitability of selections with Consultant prior to purchasing products; obtain approvals in writing.
  - .3 Make sealant selections consistent with manufacturer's recommendations.
- .2 Materials Schedule:
  - .1 Make sealant selections consistent with manufacturer's recommendations.
  - .2 Use mould & mildew resistant silicone sealant Type S-1 for non-moving joints in washrooms and kitchens. Do not use on floors.
  - .3 Use silicone general construction sealant Type S-2 for all exterior air and vapour control system applications, with the exception of concrete and unit masonry substrates, for which locations use type S-5A.
  - .4 Use silicone sealant type S-5A for concrete and unit masonry substrates unless specified otherwise on structural Drawings or Specifications in which case the structural Drawings and Specifications take precedence.

- .5 Use silicone general construction sealant Type S-2 or Type S-5A for all joints, interior and exterior, where no other specific sealant type specified.
  - .6 Use structural glazing silicone Type S-3 for sealing glass.
  - .7 Use acoustical sealant Type S-4 and air seal sealant Type S-2 only where they will be fully concealed and only where no constant or consistent air pressure difference will exist across the joint.
  - .8 Use type S-5A, priming penetration element surfaces other than concrete, for mechanical and electrical service penetrations in concrete foundation walls.
  - .9 Use wet area sealant S-10 for horizontal and vertical joints, and perimeter joints, at showers and tub rooms, exterior door threshold plates, and other wet area applications and water control layer at exterior wall assemblies. Use traffic grade (TG) at horizontal floor locations as required.
  - .10 For sealing joints at insulated metal wall panels, refer to Section 07 42 13.19(R2) - Insulated Metal Wall Panels for materials and application requirements.
  - .11 Where concrete masonry units meet insulated metal wall panels, and where gypsum board meets insulated metal wall panels, sealant at these locations shall be either for acoustic purposes or for fire-rated firestop purposes. For firestop and smoke seal requirements, refer to Section 07 84 00 Firestopping and Smoke Seals.
- .3 Exterior Sealant Guidelines:
- .1 The following list is provided for general guidance and is not intended to exhaust all of the locations where sealant is required. Refer to item 3.9.1 General Provisions of this Section for general provisions.
  - .2 Exterior sealant work is part of the work of this section. Install exterior sealant to:
    - .1 General: seal open joints in surfaces exposed to view and as required to make the building weather-tight and airtight.
    - .2 Exterior joints between dissimilar materials.
    - .3 Perimeters of exterior openings where frames meet exterior façade of building.
    - .4 Exterior joints in horizontal wearing surfaces.
    - .5 Exterior intake and exhaust louvers. Provide space in sealant at bottom for drainage.
    - .6 Below door thresholds (2 beads).
    - .7 Penetrations through exterior building elements.
    - .8 Where indicated on Drawings.
- .4 Interior Sealant Guidelines:
- .1 The following list is provided for general guidance and is not intended to exhaust all of the locations where sealant is required. Refer to item 3.9.1 General Provisions of this Section for general provisions.

- .2 Install interior sealant to:
  - .1 Movement and control joints on exposed in-place 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.
  - .4 Perimeters of exterior door, curtain wall and window frames.
  - .5 Joints at tops of non-load bearing masonry walls at the underside of metal deck or in-place concrete, except where fire sealant and smoke sealant required.
  - .6 As indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 04 22 00 – Unit Masonry.
- .2 Section 05 50 00 – Metal Fabrications.
- .3 Section 06 10 00 – Rough Carpentry.
- .4 Section 07 92 00 – Joint Sealants.
- .5 Division 08: Door Hardware Schedule and Groups.
- .6 Section 09 91 00 – Painting.
- .7 Section 13 34 19 – Pre-engineered Metal Building RFQ.
- .8 Divisions 26 and 28: Wiring and hookup for electronic hardware and security systems.
- .9 Refer to Door Schedule on Drawings.

**1.2 REFERENCES**

- .1 American National Standards Organization (ANSI) / Steel Door Institute (SDI)
  - .1 ANSI/SDI A250.3-2025, Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames.
  - .2 ANSI/SDI A250.8-2023, Recommended Specifications for Standard Steel Doors and Frames.
  - .3 ANSI/SDI A250.10-2025, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
  - .4 ANSI/SDI A250.11-2022, Recommended Erection Instructions for Steel Frames.
- .2 ASTM International (ASTM)
  - .1 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .3 ASTM A879/A879M-22, Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
  - .4 ASTM A924/A924M-22a, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - .5 ASTM C553-24, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .6 ASTM C578-23, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - .7 ASTM C591-22, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - .8 ASTM C1289-25, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .9 ASTM C1363-24, Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
  - .10 ASTM D1622-20, Standard Test Method for Apparent Density of Rigid Cellular Plastics.



- .11 ASTM D4726-24, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors.
- .12 ASTM D6386-22, Standard Practice for Preparation of Zinc (Hot Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
- .13 ASTM D7396-14(2020), Standard Guide for Preparation of New, Continuous Zinc-Coated (Galvanized) Steel Surfaces for Painting.
- .14 ASTM E283/E283M-19, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .3 Builders Hardware Manufacturers Association (BHMA)
  - .1 ANSI/BHMA A156 series of standards, most recent published editions.
- .4 CSA Group (CSA)
  - .1 CSA G40.20-13/G40.21-13 (R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CSA W47.1:19, Certification of companies for fusion welding of steel.
  - .3 CSA W59-18 (R2023), Welded Steel Construction, Includes Errata (2020).
- .5 Canadian Steel Door Manufacturers' Association (CSDMA)
  - .1 CSDMA, Recommended Selection and Usage Guide for Commercial Steel Door and Frame Products, 2025.
  - .2 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames
  - .3 CSDMA, Storage and Installation Guide, 2025.
  - .4 CSDMA, Fire Labeling Guide, 2025.
- .6 National Fire Protection Association (NFPA)
  - .1 NFPA (Fire) 80, Standard for Fire Doors and Other Opening Protectives, 2025 Edition.
  - .2 NFPA (Fire) 252, Fire Tests of Door Assemblies, 2022 Edition.
- .7 The Society for Protective Coatings (SSPC)
  - .1 SSPC-PS 12.01, One Coat Zinc-Rich Painting System.
  - .2 SSPC-PS Guide 12.00, Guide to Zinc-Rich Coating Systems.
- .8 CSA Group (CSA)
  - .1 CSA W59
- .9 ULC Standards (ULC)
  - .1 CAN/ULC 104-15, Standard Method for Fire Tests of Door Assemblies.
  - .2 CAN/ULC 105:2016, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.
  - .3 CAN/ULC 106-15, Standard Method for Fire Tests of Window and Glass Block Assemblies.
  - .4 ULC 702.1:2021, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .5 ULC 702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
  - .6 ULC 704.1-17, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

- .7 ULC S705.1, Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material Specification, 12/18/2018.
- .8 ULC 705.2, Standard for Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Application, 07/08/2020.

### **1.3 PERFORMANCE AND DESIGN REQUIREMENTS**

- .1 Perform work in accordance with CSDMA Recommended Specifications for Commercial Steel Doors and Frames except as otherwise specified herein.
- .2 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.
- .3 Exterior doors and frames shall be insulated.
- .4 All frames shall be welded; coordinate installation with partition and exterior wall construction as required to ensure proper integration of welded frames during construction.
- .5 Maximum deflection for exterior steel doors under wind load of 1.2 kPa not to exceed 1/175th of span.
- .6 Exterior Door and Frame Assemblies:
  - .1 Thermal Transmittance: minimum R-value of 3.4 to ASTM C1363.
  - .2 Air Infiltration: < 0.1 cfm/ft<sup>2</sup> to ASTM E283.
- .7 Steel fire rated doors and frames: Label and list fire rated doors and frames by an organization accredited by the Standards Council of Canada in conformance with ULC 104 and ULC 105 for ratings specified or indicated. Fire labels must be factory applied by the manufacturer.
- .8 Be responsible for securing approval from authorities having jurisdiction for materials, fabrication and installation of fire rated door and frame assemblies.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's published product literature, specifications and data sheets for each type of door and frame specified.
- .3 Shop Drawings:
  - .1 Indicate each type of door, frame, steel, construction and core.
  - .2 Indicate material thickness, mortises, reinforcements, anchorages, locations of exposed fasteners, openings (glazed, paneled or louvered) and arrangement of standard hardware.
  - .3 Indicate section-through profiles and dimensions for both standard and narrow profile frames.
  - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on Drawings and Door Schedule included on Drawings.
  - .5 Do not order doors or frames until Shop Drawings have been reviewed and accepted by Consultant.

## 1.5 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator: member in good standing of the Canadian Steel Door and Frame Manufacturer's Association.
- .2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:
  - .1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
  - .2 Fabricate all rated doors and frames to labelling authority standard.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements, and as follows:
  - .1 Receive and store materials as recommended by materials manufacturer.
  - .2 Adequately protect surfaces from damage during moving, handling and storage.

## 1.7 WARRANTY

- .1 Provide manufacturer's standard limited warranty for products supplied under this Section.

## Part 2 Products

### 2.1 MATERIALS

- .1 Steel and corrosion protection requirements:
  - .1 Supply products manufactured from Canadian-produced steel.
  - .2 Doors and frames at showers and washrooms: steel sheets to ASTM A924M; coating designation to ASTM A653M, Commercial Steel (CS), Type B, Z275 hot dipped galvanized (275 g/m<sup>2</sup>); stretcher-levelled standard of flatness.
  - .3 Doors and frames at all other locations, exterior and interior: coated steel sheets to ASTM A924M; coating designation to ASTM A653M, Commercial Steel (CS), Type B, ZF120 (120 g/m<sup>2</sup>) galvanized; stretcher-levelled standard of flatness.
- .2 Minimum thickness requirements:
  - .1 Doors and frames:
    - .1 Exterior galvanized steel: 1.60 mm nominal coated thickness.
    - .2 Interior galvanized steel: 1.30 mm nominal coated thickness.
    - .3 Interior galvanized steel: 1.30 mm nominal coated thickness.
  - .2 Hardware Reinforcement for Doors and Frames: Carbon steel, welded in place, prime painted, to extend full width and length of hardware installation at location where hardware is to be attached and at the frame as required, to the following minimum nominal base metal thicknesses:

Hardware Reinforcement	Door (mm)	Frame (mm)
Pivot Hinge:	4.20 (0.16")	4.20 (0.16")
Mortise Hinge:	3.51 (0.14")	3.51 (0.14")
Mortise or Bored Lock or Deadbolt:	1.98 (0.08")	1.98 (0.08")
Flush or Surface Bolt Front:	1.98 (0.08")	1.98 (0.08")

<b>Hardware Reinforcement</b>	<b>Door (mm)</b>	<b>Frame (mm)</b>
Surface or Concealed Closer:	2.74 (0.11")	2.74 (0.11")
Strike Reinforcements:	1.98 (0.08")	1.98 (0.08")
Hold Open Arm:	1.98 (0.08")	1.98 (0.08")
Electronic Hardware Reinforcements:	1.98 (0.08")	1.98 (0.08")
Pull Plates and Bars:	1.30 (0.05")	1.30 (0.05")
Mortar Box:	--	0.84 (0.03")
Surface Exit Devices:	1.98 (0.08")	1.98 (0.08")
Door Surface Hardware Reinforcements:	1.30 (0.05")	1.30 (0.05")
Frame surface hardware reinforcements:	2.74 (0.11")	2.74 (0.11")

- .3 Door Core Materials:
  - .1 Honeycomb: Structural small cell 25 mm (1") maximum. kraft paper honeycomb:
    - .1 Weight: 36.3 kg/ream minimum.
    - .2 Density: 16.5 kg/m<sup>3</sup> minimum.
    - .3 Sanded to required thickness.
  - .2 Polystyrene: Rigid extruded, closed cell insulation, fire retardant treated to ULC S701, Type 4, minimum thermal resistance RSI 0.8/25 mm thickness.
  - .3 Polyurethane: rigid, cellular type, board, conforming to ASTM D1622, or foamed-in-place, 1.8 pound per cubic foot (29 kg/m<sup>3</sup>) density minimum, containing no urea formaldehyde resins. U-factor 0.29 (ASTM C1363).
  - .4 Polyisocyanurate Core: to CAN/ULC-S704, rigid closed cell board.

## 2.2 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
  - .1 Adhesive: maximum VOC content 50 g/L to SCAQMD Rule 1168.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .3 Interlocking Edge Seam Adhesive: fire-resistant, resin-reinforced polychloroprene, high-viscosity, sealant/adhesive.

## 2.3 ACCESSORIES

- .1 Door silencers (bumpers): Black neoprene, to ANSI/BHMA A156.16 Type 6-180; three silencers on strike jambs of single door frames; two silencers on heads of double door frames; screw fastener applied. Stick on bumpers are not acceptable.
- .2 Interior top caps: steel.
- .3 Exterior top and bottom caps: rigid polyvinylchloride extrusion, to ASTM D4726.
- .4 Fabricate glazing stops as formed channel, minimum 16 mm (0.63") height, accurately fitted, butted at corners, and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .5 Make provisions for glazing as indicated and provide necessary glazing stops.
  - .1 Provide removable glazing beads.
  - .2 Exterior glazing stops: Tamperproof.
- .6 Metallic paste filler: to manufacturer's standard.

- .7 Fasteners: type 304 stainless steel screws with countersunk flat head.
- .8 Labels for fire doors and door frame: brass plate, riveted to door and door frame.
- .9 Sealant: Section 07 92 00 – Joint Sealants.
- .10 Glazing: Section 08 80 50 –Glazing.
- .11 Dielectric Separator / Isolation Coating: C.R. Laurence bituminous paint or aerosol, or equivalent.

## **2.4 DOOR HARDWARE**

- .1 Door hardware: refer to Door Schedule on Drawings, and door hardware schedule and groups.
- .2 Provide construction cores.

## **2.5 MANUFACTURED FRAMES**

- .1 Steel and corrosion protection requirements: as per item 2.1.1 of this Section. Frame type and configuration to suit wall type and location.
- .2 Exterior Pressed Steel Frames: sheet steel, 1.60 mm nominal coated thickness, with paintable galvaneal finish; two-piece construction with continuous thermal break; sizes and configurations as indicated on Drawings.
  - .1 Standard of Acceptance:
    - .1 Therma-Series Frame, by Fleming Door Products Ltd.
- .3 Interior Pressed Steel Frames: sheet steel, 1.30 mm nominal coated thickness, with paintable galvaneal finish (Z275 hot dipped galvanized at washroom and shower doors); maximum 25 mm face and 4.5 mm wide stop; sizes and configurations as indicated on Drawings.
  - .1 Standard of Acceptance:
    - .1 TW-Series Frame, by Fleming Door Products Ltd.

## **2.6 FABRICATION GENERAL**

- .1 Welded construction: assemble units by welding in accordance with CSA W59 to produce a finished unit square, true, and free of distortion. Welding shall be continuous unless specified otherwise. Welding shall be undertaken only by a fabricator fully approved by the Canadian Welding Bureau to the requirements of CSA W47.1.
- .2 Permit access by an approved inspection and testing company for the purpose of inspecting at random, doors being fabricated for this project.
- .3 Make provisions in doors and frames to suit requirements of trade or section providing electrically operated hardware or security devices. Provide removable plates or knock outs for electrical contacts. Provide junction boxes on security door frames as required for door strikes, mag locks and door contacts. Ensure frames arrive on site prepared for wiring.
- .4 Fabricate galvanized steel channels to reinforce frames as required for size, and for fire protection rating requirements. Extend reinforcements from floor to structure above. Design top connection to accommodate structural deflection. Conceal reinforcements in frames.

## **2.7 FABRICATION – FRAMES AND SCREENS**

- .1 Fabricate frames in accordance with CSDMA specifications; minimum metal thicknesses and corrosion protection as specified per item 2.1 of this Section. Frames shall meet the requirements of item 2.5 of this Section.
- .2 Provide narrow profile frames at all office areas and at shower doors. Submit Shop Drawings showing profile and dimensions to Consultant prior to ordering to confirm acceptance.
- .3 Accurately form frames to profiles indicated. Construct frames straight and free from twist or warp.
- .4 Supply frames to suit construction conditions and indicated dimensions. All frames installed within the building envelope shall be thermally broken.
- .5 Assemble components with accurately cut joints. Mitre outside corner joints of frames. Continuously weld joints on inside of profile and grind welds, flush and sand to smooth uniform surface; tabbed and spot-welded connections are not acceptable.
- .6 Provide recessed sheet steel panels, bases, and covers, where indicated, minimum 2 mm thick. At fire rated screens, construct panels, bases, and covers in accordance with fire test requirements. Weld panels, bases, and covers to perimeter framing in concealed manner where possible; where welds are exposed, provide continuous welds. Reinforce or laminate panels, bases, and covers as required to provide a flat uniform surface.
- .7 Fill concealed void at exterior frames, between frame and rough opening, in accordance with ULC S705.1 and ULC S705.2.
- .8 On factory-assembled frame product, provide two removable steel jamb spreaders welded to the base of the jambs or mullions to maintain alignment during shipping and handling. Remove spreaders prior to anchoring frames to floor.
- .9 Brace frame units to prevent distortion and protect finish during shipment.
- .10 Install three bumpers in interior frames at single opening latch jambs, and two at double door frame heads.
- .11 Provide mullions and rails of closed construction type. For fixed condition, attach members to frame with butt-welded joints. For removable condition, attach members with removable mullion anchors.
- .12 Conceal fastenings unless otherwise indicated.
- .13 Fasten removable stops by counter-sunk Phillips head screws at approximately 225 mm (9") on centre symmetrically space on stop length.
- .14 Form Door stops and glass stops integrally with frame and not added as a separate profile.
- .15 Anchor frames to floor by 1.6 mm (0.063") thick adjustable base clips, welded to frame and Provide with 2 holes for floor anchorage.

- .16 Provide minimum 3 mm (1/8") anchors for connection to adjacent 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 610 mm (24") 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. Fasteners for such anchors shall be provided by Section 06 20 00. Anchors for stainless steel frames shall be Type 316L stainless steel.
- .17 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. Provide steel sleeves between frame and wall.
- .18 Protect strike and hinge reinforcements using guard boxes welded to frames at masonry construction. Provide guard boxes welded to frame at hinges, strikes, door alarm contacts, switches, and other hardware items recessed into frames.
- .19 Reinforce head of frames wider than 1220 mm (48") with steel angles or channels.
- .20 Prepare door frames for security system contacts. Coordinate with Division 26.
- .21 Provide welded-on drip at head of exterior door frames.
- .22 Hardware reinforcements shall be minimum thicknesses as specified, not including frame thickness. Provide reinforcement at hardware fastening points. Provide high frequency (angle type) reinforcement at hinges. Provide full height reinforcement of thicknesses at hinge side of frames with continuous hinges.

## **2.8 FRAME ANCHORAGE**

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Where frames terminate at finished floor, supply floor plates for anchorage to slab. Check depth of extension of finished floor to structural slab and provide jamb extension anchorage as required. Provide 50 mm (2") minimum adjustment.
- .3 Locate wall anchors immediately above or below each hinge reinforcement on the hinge jamb, and directly opposite on the strike jamb. Provide three anchors per jamb for frames up to 2300 mm (7'-6"). Add one anchor per jamb for each additional 760 mm (30") or fraction thereof in frame height.
- .4 Locate anchors for frames in existing openings not more than 150 mm (6") from top and bottom of each jamb and intermediate at 660 mm (26") on centre maximum.

## **2.9 FRAMES: WELDED TYPE**

- .1 Welding in accordance with CSA W59.
- .2 Cut frame mitres accurately and weld on inside of frame profile. Fill frame corners, exposed surface depressions and butted joints with air drying paste filler. Sand to a smooth uniform finish. Touch up damaged galvanized finish with zinc rich primer.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.

- .6 Weld in two temporary jamb spreaders per frame to maintain proper alignment during shipment.

## **2.10 DOOR FABRICATION: GENERAL**

- .1 Doors: swing type, flush, with provision for openings as indicated.
- .2 Fabricate do in ascendance with CSDMA specifications; minimum metal thicknesses and corrosion protection as specified per item 2.1 of this Section
- .3 Fabricate doors with longitudinal edges locked seamed with adhesive and spot-welded for larger doors. Seams: not visible, grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish. Bevel both stiles of single doors 1 in 16.
- .4 Top and bottom of doors shall be provided with inverted, recessed, nominal 2.74 mm (0.1") steel end channels, welded to each face sheet at 150 mm (6") on centre.
- .5 Equip top and bottom of acoustic doors with nominal 1.60 mm (0.063") continuous flush steel non-removable end caps welded securely in place.
- .6 Provide fixed transoms, side panels and base panels where indicated or scheduled, of same materials, gauge, thickness, construction and finish as door. Reinforce transoms and panels to prevent oil canning. Install transoms and panels with concealed fastenings, and reinforce to accommodate hardware as required. Seal joint between transom or panel airtight. Provide accurately formed ship lap joint between door and transom panel where no transom rail occurs.
- .7 Mortise, reinforce, drill, and tap doors to receive templated hardware, security, and electrical devices.
- .8 Reinforce doors where required, for surface mounted hardware. Provide flush steel top and bottom caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
- .9 Factory prepare holes 12.7 mm (1/2") diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .10 Cut-outs: Where openings are required, provide integrally formed cut-outs with steel framing, and closely fitted steel glass and grille stops, as required. Mitre corners of stops. Drill and countersink fasteners symmetrically at 150 mm (6") o.c. Supply and install coated steel stops, with same coating type and thickness as doors. Screw stops in place.
- .11 Supply and install steel vent grilles in doors where indicated.
- .12 Fabricate doors with a clearance of 3 mm (1/8") to the frame and 6 mm (1/4") to completed floor finish or threshold, except at openings in non-fire rated separations where undercuts are indicated.
- .13 Provide flush top and bottom steel edge on exterior doors and doors to stair shafts. Equip exterior doors with factory installed flush PVC top caps. Equip fire labelled exterior doors with factory installed flush steel top caps.
- .14 Provide touch-up primer at areas where zinc coating has been removed or damaged during fabrication.
- .15 Exterior doors: thermally insulated door core materials as specified.
- .16 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC S104 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.



- .17 Manufacturer's nameplates on doors are not permitted.

## **2.11 FABRICATION: EXTERIOR DOORS**

- .1 Face sheets: minimum metal thicknesses and corrosion protection as specified per item 2.1 of this Section.
- .2 Insulated and sound deadened construction: foamed-in-place polyurethane core laminated under pressure to each face sheet.
- .3 Longitudinal edges mechanically interlocked, adhesive assisted with edge seams continuous welded, filled, and sanded flush with no visible seam.
- .4 Provide all extra reinforcing at all hardware locations as required per CSDMA guidelines, and this Section.

## **2.12 FABRICATION: INTERIOR DOORS**

- .1 Face sheets: minimum metal thicknesses and corrosion protection as specified per item 2.1 of this Section.
- .2 Sound deadened construction: honeycomb core laminated under pressure to each face sheet.
- .3 Longitudinal edges mechanically interlocked, adhesive assisted with edge seams continuous welded, sanded flush with no visible seam.
- .4 Provide all extra reinforcing at all hardware locations as required per CSDMA guidelines, and this Section.

## **2.13 FABRICATION: FIRE RATED DOORS**

- .1 Face sheets: 1.60 mm galvanized steel, or as otherwise required to suit fire rating.
- .2 Fire rated core laminated under pressure to each face sheet.
- .3 Core: honeycomb core laminated under pressure to each face sheet.
- .4 Longitudinal edges mechanically interlocked, adhesive assisted with edge seams continuous welded, sanded flush with no visible seam.
- .5 Provide extra reinforcing at hardware locations as required per CSDMA guidelines, and this Section, and as required to meet fire-rating criteria.

## **2.14 PRIMER**

- .1 Shop prime doors and frames before delivery; grey or red coloured primer; use zinc-rich primer for shower and washroom doors and frames. Clear primer not acceptable; provide primers for field touch-up.

## **2.15 PAINT**

- .1 Field paint steel doors and frames in accordance with Section 09 91 00 - Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.
  - .1 Maximum VOC emission level 50 g/L to GS-11 and to SCAQMD Rule 1113.
- .2 Colour: black, semi-gloss sheen, except with the following exception:
  - .1 The two doors on the south elevation (door #100 and #117i) shall be finished with red paint system, the specific colour/hue as selected by Consultant, semi-gloss sheen.

**2.16 ISOLATION COATING**

- .1 Dielectric Separator/Isolation Coating.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's published recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

**3.2 EXAMINATION**

- .1 Examine substrates, door swing arcs, areas of installation and conditions affecting installation for compliance with requirements for manufacturer's installation tolerance and other conditions affecting performance of work of this Section.
- .2 Verify roughing-in for embedded and built-in anchor locations before installing frames.
- .3 Verify door and frame size, door swing and ratings with door opening number before installing frames.
- .4 Installation of hollow metal doors and frames will denote acceptance of site conditions.

**3.3 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2 Apply into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess material "oozes out" during assembly to ensure a proper seal.
- .4 Assemble and wipe away any excess product.

**3.4 INSTALLATION GENERAL**

- .1 Install fire rated doors and frames in accordance with requirements of NFPA 80.
- .2 Install doors and frames in accordance with reviewed Shop Drawings, ANSI/SDI A250.11, CSDMA Storage and Installation Guide, manufacturer's data sheets, and as specified in this Section.

**3.5 FRAME INSTALLATION**

- .1 Set frames plumb, square, level and at correct elevations.
- .2 Secure anchorages and connections to adjacent construction.
- .3 At exterior door locations, fill cavities between frame and wall with spray foam insulation, to ULC 705.2.
- .4 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm (4') wide. Remove temporary spreaders after frames are built-in.

- .5 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .6 Install hollow metal window and screen frames at interior locations as indicated.
- .7 Install door silencers.
- .8 Caulk perimeter of frames between frame and adjacent material.
- .9 Maintain continuity of air barrier and vapour retarder.

### **3.6 DOOR INSTALLATION**

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Division 08: Door Hardware.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
  - .1 Hinge side: 1.0 mm (0.04").
  - .2 Latchside and head: 1.5 mm (0.06").
  - .3 Finished floor, top of carpet, non-combustible sill, or thresholds: 6 mm.
- .3 Adjust operable parts for correct function.

### **3.7 FINISH REPAIRS**

- .1 Touch-up areas where galvanized coating has been removed or damaged with primer.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

### **3.8 GLAZING**

- .1 Install glazing where indicated in accordance with Division 08: Glazing. Refer to schedules on Drawings.

### **3.9 COMMISSIONING**

- .1 Test door assemblies specified in this Section to verify proper operation; make necessary adjustments.
- .2 Verify that hardware required has been furnished and installed.
- .3 Re-adjust doors and hardware just prior to completion of building to function freely and properly.
- .4 Remove packing material from assemblies and leave in clean condition ready for operation.

### **3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Progress and Final Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Progress and Final Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of waste materials in accordance with Section 01 74 19 - Construction Waste Management and Disposal.

**3.11 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.12 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 44 13 - Glazed Aluminum Framing Systems.
- .2 Section 08 80 50 - Glazing.
- .3 Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI/WDMA 1.S.1A-13, Industry Standard for Interior Architectural Wood Flush Doors.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC):
  - .1 North American Architectural Woodwork Standards (NAAWS).
- .3 Canadian Hardwood Plywood and Veneer Association (CHPVA)
  - .1 CHPA Official Grading Rules for Rotary Cut Face Veneers.
- .4 National Lumber Grades Authority (NLGA)
  - .1 NLGA Standard Grading Rules for Canadian Lumber.

**1.3 ACTION SUBMITTALS AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and data sheets.
  - .2 Submit two copies of WHMIS SDS - Safety Data Sheets. Indicate VOCs:
    - .1 For caulking materials during application and curing.
    - .2 For door materials and adhesives.
- .3 Submit shop drawings:
  - .1 Show construction and materials used in cores, size and species of edge strip, thickness and species of cross-banding, and thickness and species of face veneer.
  - .2 Indicate locations, door handing, sizes, and types of all doors to be supplied reference to the Door and Hardware Schedule.
  - .3 Indicate elevation of each kind of door, details of construction, location and extent of hardware blocking, jointing, anchors, requirements for factory finishing and other pertinent data.
  - .4 Provide details of perimeter and interface conditions.
  - .5 Include finishing specifications for doors to receive factory-applied finish.
  - .6 Include certifications as might be required to show compliance with specifications.
- .4 Submit samples:
  - .1 Submit one 300 x 300 mm corner sample of each type of wood door.
  - .2 Submit 300 x 300 mm sample for initial selection of colour and finish to Consultant for approval prior to factory-finishing.
  - .3 Show door construction, core, glazing detail and faces.

#### **1.4 QUALITY ASSURANCE**

- .1 Fabricate doors in accordance with the NAAWS, Section 9 - Doors, Custom grade.
- .2 Manufacturer Qualification: Manufacturer specializing in products in this section with minimum five years of documented experience and member in good standing of Architectural Woodwork Manufacturers Association of Canada (AWMAC).
- .3 Certifications: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Preconstruction Testing: Certified test reports showing compliance with specified performance characteristics and physical properties.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Delivery and Acceptance Requirements:
  - .1 Deliver doors and panels to minimize storage on site and when site conditions conform to requirements for storage.
  - .2 Inspect frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Consultant. Remove and replace damaged items that cannot be repaired as directed.
- .2 Storage and Protection:
  - .1 Store and handle doors and panels in accordance with NAAWS requirements, and as follows:
    - .1 Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
    - .2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.
    - .3 Protect doors from scratches, handling marks and other damage.
    - .4 Store doors away from direct sunlight.

#### **1.6 WARRANTY**

- .1 Provide warranty issued in the name of Owner stating that doors are warranted against defects in materials and workmanship for life of original installation.
- .2 Warranty to include coverage to remove, replace, refinish, and re-hang doors that do not meet accepted NAAWS tolerances.

### **Part 2 Products**

#### **2.1 FLUSH SOLID CORE DOORS**

- .1 Flush wood doors: solid core to NAAWS Standard, with glazed window where indicated.
- .2 Dry lumber to an average moisture content of between 6 and 12% maximum at time of manufacture.
- .3 Construction:
  - .1 Solid Wood Core: glued block core with wood edge band, and as follows:
    - .1 Construction: 5-ply.
    - .2 Use: interior.

- .2 Door cores to be fully bonded and abrasive planed or sanded prior to laminating faces to core materials.
- .3 Door Thickness: 45 mm overall, or as otherwise shown on Drawings if different.
- .4 Duty Rating: Heavy Performance Grade in accordance with WDMA I.S. 1-A.
- .5 NAAWS Edge Type D-Solid Wood Edge Band; crossband edge covered and veneer face edge showing.
- .4 Panel Face Material:
  - .1 Decorative Wood Veneer: NAAWS quality grade and hardwood species, supplied from same source, clear and bright in colour with minimum of pin knots, mineral or sugar streaks, no open defects, heartwood, or wild grain, and minimal colour variation between flitches, meeting the requirements for Hardwood Plywood Veneer Association (HPVA) quality grade and hardwood species as indicated.
    - .1 Grade: Custom, with Grade A faces.
    - .2 Species: Red Oak.
    - .3 Cut: rotary cut.
    - .4 Match between Veneer Leaves: Book match.
    - .5 Finish: Factory-finished (stained and lacquered) as indicated below for transparent finishes.
    - .6 Minimum Thickness: 0.50 mm.
    - .7 Paired doors to have matching veneer pattern for uniform appearance.
- .5 Glass: to Section 08 80 50 - Glazing.
- .6 Glazing Stops: Solid red oak hardwood with mitred corners; colour to match face material.

## **2.1 ADHESIVES**

- .1 Adhesives shall be Type I, urea formaldehyde free.

## **2.2 DOOR FRAMES**

- .1 Door frames: to Section 08 44 13 - Glazed Aluminum Framing Systems.

## **2.3 FABRICATION**

- .1 Fabricate doors in accordance with NAAWS section 9.
- .2 Prepare doors for glazing. Provide hardwood glazing stops with mitred corners, finished to match colour of face material.
- .3 Coordinate measurements of hardware mortises in metal frames. Contractor or door distributor to verify dimensions and alignment before factory machining.
- .4 Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame shop drawings, and hardware templates.
- .5 Light openings must be cut by the manufacturer or by a certified machining distributor.
- .6 Top and bottom rails of doors shall be factory-sealed with an approved wood sealer to eliminate moisture from entering core.
- .7 Blocking: provide blocking to eliminate through-bolting for surface applied hardware.
- .8 Top, bottom and vertical edge strips to match face material.
- .9 Doors shall be pre-fitted, bevelled and machined at factory for mortise hardware items as per templates and approved hardware schedules provided.

- .10 Bevel vertical edges of single acting doors 3 mm in 50 mm on lock side and 1.5 mm in 50 mm on hinge side.
- .11 Radius vertical edges of double acting doors to 60 mm radius.

## **2.4 FINISHES**

- .1 Factory stain and finish doors in accordance with NAAWS Section 5 – Finishing, System 9 UV-Curable, Arylated Epoxy, Polyester or Urethane as a minimum.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Inspect all doors prior to hanging. Repair noticeable marks or defects that may have occurred from improper storage or handling. Field repairs and touch-ups are the responsibility of the installing contractor upon completion of the initial installation. Field touch-up shall include repair of job inflicted mars and final cleaning of finished doors.
- .2 Examine door frames and verify that they comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
- .3 Adjust frames to plumb condition before door installation. Tolerances for warp, squareness and pre-fitting dimensions shall be as per latest edition of NAAWS.
- .4 Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.
- .5 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Install doors by removing only manufacturers protective shrink-wrap sections to install required hardware. Protective shrink-wrap to remain on doors until prior to final inspection.
- .3 Install doors and hardware in accordance with manufacturer's printed instructions and NAAWS.
- .4 Adjust hardware for correct function.
- .5 Place door unit into opening and level hinge side of jamb. Use shims fastened through jamb and stop to level and temporarily secure in place.
- .6 Level latch side of jamb. Use shims fastened through jamb and stop to level and temporarily secure in place.
- .7 Verify spacing between jamb and door is uniform on all sides. Adjust as necessary.
- .8 Drill pilot holes for screws and bolts using templates provided by hardware manufacturer.
  - .1 Exercise caution when drilling pilot holes and installing hinges so that pilot holes are not over drilled, and screws are not over torqued. Follow manufacturer's installation instructions.
- .9 Seal exposed tops and bottom rails of any doors that required site alteration.
- .10 Install glazing in accordance with Section 08 80 50 - Glazing.



- .11 Hardware installation: to Section 08 71 00 – Door Hardware.
- .12 Clean prefinished doors with a rag in concert with water or household cleaners such as Simple Green, Formula 409, or equivalent. Following use of the cleaner, the cleaned surface should be "rinse wiped" with clean water and wiped dry to remove any remaining residue.

### **3.3 ADJUSTING**

- .1 Operating: Re-hang or replace doors that do not swing or operate freely and properly.
- .2 Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt. Clean glass and glazing materials with approved non-abrasive cleaner.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.5 PROTECTION**

- .1 Protect doors and installations from damage.

### **3.6 SCHEDULE**

- .1 Install as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 04 22 00 - Unit Masonry.
- .2 Section 09 21 16 - Gypsum Board Assemblies.
- .3 Section 09 91 00 - Painting.

**1.2 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Verification: Obtain specific locations and sizes for required access doors and frames from trades, including mechanical and electrical, requiring access to concealed equipment and indicate on submittal schedule.
  - .2 Coordinate with other trades as required, and furnish items to build in to the construction in accordance with the construction schedule.

**1.3 COORDINATION AND SEQUENCING**

- .1 Coordinate Work of this Section with Work of Section 09 21 16 - Gypsum Board Assemblies, and Divisions 20 and 26. Sequence Work to avoid interferences and as required to maintain project schedule. Contractor to allocate scopes of Work under this Section as required for complete installations, coordinated with electrical and mechanical services.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Product Data: Manufacturer's technical data for each type of access door and panel assembly, including setting drawings, templates, fire-resistive characteristics, finish requirements, and details of anchorage devices.
    - .1 Include complete schedule, types, locations, construction details, finishes, latching or locking provisions, and other pertinent data.
  - .2 Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.
  - .3 Shop Drawings:
    - .1 Door and panel units: Show types, elevations, thickness of metals, full size profiles of door members.
    - .2 Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations, and types of operating hardware, and details of installation.
    - .3 General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of door and panel units.
  - .4 Submit catalogue details for each type of door illustrating profiles, dimensions, and methods of assembly.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for cleaning and maintenance of stainless steel finishes for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

## **1.6 QUALITY ASSURANCE**

- .1 Single Source Responsibility: Obtain access door and panel units, and frames for entire Project from one source and a single manufacturer.
- .2 Size Variations: Obtain Consultant acceptance of manufacturer's standard size units that may vary slightly from sizes indicated on Drawings.
- .3 Coordination: Provide inserts and anchoring devices that will be built into other Work for installation of access door assemblies. Coordinate delivery with other Work to avoid delay.
- .4 Installer Qualifications: Installer with 5 years experience in the installation of manufacturer's products or other similar products as specified.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Apply temporary protective coating to finished surfaces. Remove coating after erection. Do not use coatings that will become hard to remove or leave residue.
- .3 Leave protective covering in place until final cleaning of building.

## **1.8 WARRANTY**

- .1 Warrant materials and workmanship against defects after completion and final acceptance of Work.
- .2 Repair defects, or replace with new materials, faulty materials, or workmanship developed during the warranty period at no expense to Owner.
- .3 Access Panel Warranty: 2 years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 CONCEALED FLANGE ACCESS PANELS FOR CEILINGS AND WALLS**

- .1 Architectural, flush mounting access panels for gypsum board and/or masonry installation, thickness and fire rating to match assembly, manufacturer's standard sizes selected to suit project conditions and access requirements.
- .2 Fire resistance rated and regular as required to match rating of adjacent assembly.
- .3 Concealed Flange Access Panels (Regular):
  - .1 Standard of Acceptance:
    - .1 Van-Met® Model NDB – Drywall Bead Flange, by Maxam Metal Products Ltd., or approved equivalent.
      - .1 Panel: 1.99 mm (14 ga.) satin-finished galvanized steel.
      - .2 Frame: 1.61 mm (16 ga.) satin-finished galvanized steel with a drywall bead tapping flange.
      - .3 Hinge: concealed zinc plated spring hinge (opens 175°).
      - .4 Lock/Latch: flush screwdriver operated cam lock.
      - .5 Finish: Rust inhibitive off-white prime coat.

- .4 Concealed Flange Fire-Resistance Rated Wall Access Panels:
  - .1 Standard of Acceptance:
    - .1 Van-Met® Model FDB – Two Hour Fire-Rated Uninsulated for Wall Application, by Maxam Metal Products Ltd., or approved equivalent.
      - .1 Panel: 1.99 mm (14 ga.) satin-finished galvanized steel, self-closing.
      - .2 Frame: 1.61 mm (16 ga.) satin-finished galvanized steel with a drywall bead taping flange.
      - .3 Hinge: concealed zinc plated spring hinge (opens 175°).
      - .4 Lock/Latch: flush mount ¼" allen key.
      - .5 Finish: Rust inhibitive off-white prime coat.
      - .6 Insulation: None.
- .5 Concealed Flange Fire-Rated Ceiling Access Panels:
  - .1 Standard of Acceptance:
    - .1 Van-Met® Model FCB-150 – Two Hour Fire-Rated Insulated for Wall or Ceiling Application, by Maxam Metal Products Ltd., or approved equivalent.
      - .1 Panel: 1.31 mm (18 ga.) satin-finished galvanized steel, self-closing.
      - .2 Liner: 0.85 mm (22 ga.) satin-finished galvanized steel.
      - .3 Frame: 1.61 mm (16 ga.) satin-finished galvanized steel with a drywall bead taping flange.
      - .4 Hinge: concealed continuous rod hinge.
      - .5 Lock/Latch: flush mount ¼" allen key.
      - .6 Finish: Rust inhibitive off-white prime coat.
      - .7 Insulation: 38 mm (1-1/2").
- .6 Sizes: Except as indicated otherwise, to be typical sizes as follows:
  - .1 For more than one (1) valve: 457 x 457 mm.
  - .2 For body entry: 610 x 610 mm.
  - .3 For hand entry: 152 x 152 mm and 305 x 305 mm.
  - .4 Custom sizes may be used where required following review by Consultant.
- .7 Dielectric Separator / Isolation Coating: C.R. Laurence bituminous paint or aerosol, or equivalent.

## **2.2 EXTERIOR FLANGE METAL ACCESS DOORS AND PANELS FOR CEILINGS AND WALLS**

- .1 Architectural, flush mounting access panels for gypsum board and/or masonry installation, thickness and fire rating to match wall assembly, manufacturer's standard sizes selected to suit project conditions and access requirements, complete with extruded aluminum frame, concealed hinge and a removable door panel, air tight gasket and hex head cam lock mechanism.
- .2 Fire resistance rated and regular as required to match rating of adjacent assembly.

- .3 Exterior Flange Access Panels:
  - .1 Standard of Acceptance:
    - .1 Van-Met® Model NSM – Exterior Flange, by Maxam Metal Products Ltd., or approved equivalent.
      - .1 Panel: 1.99 mm (14 ga.) satin-finished galvanized steel.
      - .2 Frame: 1.61 mm (16-ga) satin-finished galvanized steel.
      - .3 Hinge: concealed zinc plated spring hinge.
      - .4 Lock / Latch: flush screwdriver operated cam latch.
      - .5 Finish: Rust inhibitive off-white prime coat.
- .4 Exterior Flange Fire-Rated Access Panels:
  - .1 Standard of Acceptance:
    - .1 Van-Met® Model FCI-150 – Two Hour Fire-Rated Insulated for Wall or Ceiling Application, by Maxam Metal Products Ltd. , or approved equivalent.
      - .1 Panel: 1.31 mm (18 ga.) satin-finished galvanized steel, self-closing.
      - .2 Liner: 0.85 mm (22 ga.) satin-finished galvanized steel.
      - .3 Frame: 1.61 mm (16 ga.) satin-finished galvanized steel with a exterior flange.
      - .4 Hinge: concealed continuous rod hinge.
      - .5 Lock/Latch: flush mount ¼" allen key.
      - .6 Finish: Rust inhibitive off-white prime coat.
      - .7 Insulation: 38 mm (1-1/2").
- .5 Sizes: Except as indicated otherwise, to be typical sizes as follows:
  - .1 For more than one (1) valve: 457 x 457 mm.
  - .2 For body entry: 610 x 610 mm.
  - .3 For hand entry: 152 x 152 mm and 305 x 305 mm.
  - .4 Custom sizes may be used where required following review by Consultant.
- .6 Isolation Coating: bituminous paint or aerosol.

### **Part 3 Execution**

#### **3.1 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2 Apply isolation coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess isolation coating “oozes out” during assembly to ensure a proper seal.
- .4 Assemble and wipe away any excess product.

### **3.2 INSTALLATION**

- .1 Installation: Install metal access panels as directed by Consultant, and in accordance with manufacturer's printed installation instructions, installation details and illustrations, and technical datasheets.

### **3.3 LOCATIONS**

- .1 Locations: ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.

### **3.4 ADJUSTING**

- .1 Adjust panels and doors after installation for smooth operation.
- .2 Remove and replace panels or frames that are warped, bowed, or damaged.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Progress and Final Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Progress and Final Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Construction Waste Management and Disposal.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.7 SCHEDULE**

- .1 Consult Drawings and locate access doors where access is required and/or shown. Exact locations determined by Consultant.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 04 22 00 – Unit Masonry.
- .2    Section 05 50 00 – Metal Fabrications.
- .3    Section 06 10 00 – Rough Carpentry.
- .4    Section 13 34 19 – Pre-engineered Metal Building RFQ.
- .5    Section 26: Electrical power supply

**1.2            REFERENCES**

- .1    Aluminum Association (AA):
  - .1    AA DAF 45-2003 (R2009), Designation System for Aluminum Finishes.
- .2    American Society of Civil Engineers (ASCE)
  - .1    ASCE 7 Minimum Design Loads for Buildings and Other Structures.
- .3    Fenestration and Glazing Industry Alliance (FGIA):
  - .1    AAMA 2605-22-Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
  - .2    AAMA CW-10-15, Care and Handling of Architectural Aluminum from Mill, to Fabricator, to Job Site, Through Project Completion.
- .4    American Society for Testing and Materials International, (ASTM):
  - .1    ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2    ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .3    ASTM A229/A229M-24, Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs.
  - .4    ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .5    ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .6    ASTM D3363-22, Standard Test Method for Film Hardness by Pencil Test.
  - .7    ASTM E283/E283M-19, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .5    Canadian General Standards Board (CGSB):
  - .1    CAN/CGSB 12.1-2017, Safety Glazing.
  - .2    CAN/CGSB 12.8-2017, Insulating Glass Units.
- .6    CSA Group (CSA)
  - .1    CSA-G40.20-13/G40.21-13 (R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes update No.1 (2014).
  - .2    CSA G164-18 (R2023), Hot Dip Galvanizing of Irregularly Shaped Articles, Includes Update No.1 (2020).

- .3 CSA W47.1:19 (R2024), Certification of companies for fusion welding of steel.
- .4 CSA W47.2-11 (R2020), Certification of companies for fusion welding of aluminum, Includes Update No. 1 (2011), Update No. 2 (2012).
- .5 CSA W55.3-08 (R2023), Certification of companies for resistance welding of steel and aluminum.
- .6 CSA W59:24, Welded Steel Construction.
- .7 CSA W59.2:24, Welded Aluminum Construction.
- .7 Door & Access Systems Manufacturers Association (DASMA)
  - .1 ANSI/DASMA 102-2018: Specifications for Sectional Doors.
- .8 National Electrical Manufacturer's Association (NEMA):
  - .1 ANSI/NEMA 250-2020, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- .9 Underwriters Laboratory (UL)
  - .1 UL 325-2017, Door, Drapery, Gate, Louver, and Window Operators and Systems.
- .10 Underwriters Laboratory of Canada (ULC)
  - .1 ULC S705.1, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material – Specification, 12/18/2018.
  - .2 CAN/ULC S770-15, Standard Test Method for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Project Manager, Consultant, installer, manufacturer's representative to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building trades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals shall meet the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Submit product data:
  - .1 Submit manufacturer's printed product literature, specifications, and datasheets.
  - .2 Door operator motor information indicating nameplate data and ratings, characteristics, and mounting arrangements.
- .3 Submit Shop Drawings:
  - .1 Indicate sizes, service rating, types, materials, operating mechanisms, glazing locations and details, hardware and accessories, required clearances and electrical connections.
  - .2 Attachments to structure shall be designed by a delegated design professional engineer (P.Eng.) licenced to practice in the Province of Ontario.
  - .3 The geotechnical engineer has recommended that the site be classified as "Site Class D" for structural design purposes in the absence of a site-specific dynamic analysis.



- .1 Design, erect and install overhead door systems to meet OBC requirements for Class D seismic conditions, or as otherwise determined by a professional engineer (P.Eng.) licensed to practice in the Province of Ontario based on OBC calculations.
- .4 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .4 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.
- .5 Manufacturers' Field Reports: submit copies of manufacturer's field reports.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit closeout submittals as specified in Section 01 78 00.
- .2 .2 Operation and Maintenance Data: Manufacturer's standard operating instructions, and
- .3 maintenance and cleaning guidelines, including lubricating schedule, and adjusting
- .4 procedures; sufficient quantity for inclusion in operation and maintenance manual.
- .5 Radio Control Activation Devices: submit to Owner at time of application for review of Substantial Performance two hand-held remote-control transmitters for each door.

## **1.6 QUALITY ASSURANCE**

- .1 Manufacturer: Obtain sectional overhead doors of the same type, and related component materials, through one source from a single manufacturer and as follows:
  - .1 Obtain operators from sectional overhead door manufacturer.
  - .2 Obtain controls from sectional overhead door manufacturer.
- .2 Fabricator: A firm specializing in fabricating aluminum-framed glazed sectional overhead doors, having minimum 5 years documented experience and a member of DASMA.
- .3 Installer: A firm specializing in installing aluminum-framed glazed sectional overhead doors, having minimum 5 years documented experience.
- .4 Welders: Workers certified by CWB to CSA W47.1, CSA W47.2 and CSA W55.3.
- .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .6 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria, and physical requirements.
- .7 Regulatory Requirements: electrical components, devices, and accessories are listed and labelled by CSA Group (CSA).

## **1.7 WARRANTY**

- .1 Submit manufacturer's special extended warranty for parts and components, minimum 5 years from date of Substantial Performance.
- .2 Submit manufacturer's special extended warranty for heavy-duty springs: maximum cycles on a single shaft line.

**Part 2 Products**

**2.1 ACCEPTABLE MANUFACTURERS**

- .1 Manufacturers having Product considered acceptable for use:
  - .1 Cornell Iron Works.
  - .2 Cookson.
  - .3 Clopay Corporation.
- .2 Substitution Procedures: Refer to Section 01 25 00 - Substitution Procedures.

**2.2 DESCRIPTION**

- .1 Overhead Doors: aluminum-framed full-view glazed sectional overhead doors; rapid operation; high-cycle rated for emergency vehicle facilities; motor-operated with radio control transmitters, push button controls, photo eye controls; construction design intent and door sizes as per Drawings.
  - .1 Standard of Acceptance:
    - .1 EX904U Aluminum Full View Sectional Door, Polyurethane Insulated, by Cornell Iron Works, or approved equivalent.

**2.3 COMPONENTS**

- .1 Maximum Door Size: 16 ft, 2 inches (4.93 m) wide by 14 ft (4.27 m) high.
- .2 Panels Sections: 2-1/8 inches (54 mm) thick extruded 6053-T5 aluminum.
- .3 Rails and Stiles: Polyurethane foam injected.
- .4 Stiles: Double end stiles
- .5 Rollers: Long-stem tandem rollers.
- .6 Astragal: U-shaped flexible PVC in retainer of full-length 0.055 inch (1.4 mm) rigid PVC.
- .7 U-Factor: 0.86 (with clear insulated glass)
- .8 R-Value: 3.8 (with clear insulated glass)
- .9 Air Infiltration: 0.15cfm/ft<sup>2</sup>.
- .10 Custom Aluminum Finish:
  - .1 Black anodized.
- .11 Windows: Extruded polypropylene windows measuring 8 inches by 24 inches (200 mm by 600 mm).
  - .1 Glazing thickness:
    - .1 1/2-inch (13mm).
  - .2 Glazing type:
    - .1 Insulated tempered glass.
  - .3 Polystyrene Insulated Aluminum Panel: at bottom panel row as shown on Drawings.
  - .4 Glazing tint: custom light gray to match insulated glass units, per Section 08 80 50 Glazing
- .12 Locking:
  - .1 Provide one inside slide lock with interlock.
- .13 Weather-stripping: Provide complete perimeter seals. Provide flexible top seal, flexible jamb seal and U-shaped bottom seal

- .14 Track:
  - .1 3 inches (75 mm) track designed for 3" diameter rollers. Vertical and horizontal tracks minimum 0.096 inch (2.43 mm) galvanized steel.
  - .2 Provide standard lift track as indicated.
- .15 Spring Counterbalance:
  - .1 Specialized torsion spring counterbalance mechanism sized to weight of the door. Spring to be helically wound, oil tempered, treated with secondary process to increase cycle life and reliability. Spring to be mounted on a solid steel shaft with center coupling
  - .2 Cable drum of die cast aluminum with high strength galvanized aircraft cable with minimum 7 to 1 safety factor. Cable to be at minimum 7-19 stranded 3/16 diameter with thimble loop.
  - .3 Cable Safety Device: Snubbers to help maintain cable tension.
  - .4 Spring cycles:
    - .1 Maximum cycles on a single shaft.

## 2.4 DOOR OPERATOR

- .1 Manufacturer: Liftmaster.
  - .1 Motor design: 1.25 HP
    - .1 3-phase, 575V with supplementary step-down transformer provided by manufacturer.
- .2 Operation: Variable speed direct drive.
- .3 Minimum Operator Speed: Travels minimum 24" per seconds in the up direction and 18" per second in the down direction. Includes soft start/stop ramps.
- .4 Motor: Listed by Underwriters Laboratories. Meet UL 325.
- .5 Wall controller: Provide separation of low and high voltage wiring and include functionality of 3-button station; set door profile and programming limits, and performs diagnostics.
- .6 Floor-level programming: Set limits, door profile, operating modes, and select photo entrapment devices via wall controller from standing height.
- .7 Display: Absolute cycle count, service cycle count, diagnostic messages, and door and operator status via 2-line, text LED display.
- .8 Cycle counter: Resettable via wall controller or myQ technology.
- .9 Limit setting: Electronic pushbutton via wall controller.
- .10 Manual Hoist: Manual hoist with integral manual operation protection circuit.
- .11 Cable Tension Monitor: Mitigates door operation when cable slackening occurs.
- .12 Internet connectivity:
  - .1 Built-in Wi-Fi with myQ technology.
  - .2 Over-the-air updates.
- .13 Service cycle count, lifetime cycle count, and remote diagnostics via wall controller or myQ technology.
- .14 Control Stations:
  - .1 Three Button Type:
    - .1 NEMA 4X enclosure.

- .15 Remote Controls:
  - .1 Four button learning Security+ 2.
  - .2 Individual radio controls for each overhead door, with a separate frequency set to allow opening and closing of door for designated bay.
- .16 Primary monitored entrapment protection:
  - .1 Light Curtain UL 325 approved (standard).
- .17 Secondary non-monitored entrapment protection:
  - .1 Photo eyes, flexible housing; to delay door closing until opening is clear, to reset door at full-open position and reset timer.
- .18 Accessories:
  - .1 Commercial/Industrial wireless keypad.
  - .2 Commercial access control receiver.
  - .3 Microwave motion detector.

## **2.5 FABRICATION**

- .1 Prior to fabrication, verify existing conditions and take field measurements necessary to ensure perfect fit.
- .2 Fabricate sectional overhead doors to ANSI/DASMA 102.
- .3 Weld steel components to CSA W59.
- .4 Weld aluminum components to CSA W59.2.
- .5 Completely fill aluminum stiles and rails with insulation.
- .6 Provide top and bottom flexible weatherstripping.
- .7 Fabricate components such that door will overlap frames by minimum 25 mm on each side to accommodate track adjustment.
- .8 Install glass as per door manufacturer's specifications and installation instruction

## **2.6 FINISHES**

- .1 Exposed Aluminum: factory powder coated to AAMA 2605, black colour to match curtain wall framing as closely as possible.
- .2 Unexposed Aluminum: mil finish.
- .3 Galvanized Coating on Steel Components: to ASTM A123/A123M, Coating Grade 55; hot dipped zinc alloy coating.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Compliance:
  - .1 Comply with manufacturer's published installation instructions, specifications, standard details, and data sheets.
  - .2 Comply with reviewed engineered Shop Drawings.

### **3.2 EXAMINATION**

- .1 Examine wall and overhead areas, including opening framing and blocking, with installer present, for compliance with requirements for installation tolerances, clearances, and other conditions affecting performance of Work in this Section.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.
- .3 If substrate preparation is the responsibility of another entity, notify Architect of unsatisfactory preparation before proceeding.

### **3.3 PREPARATION**

- .1 Coordinate with other trades as required for primary power with local NEMA-4X fused disconnect to be installed near each overhead door jamb, complete with 20-amp service.
- .2 Provide electrical control wiring and electrical connections from local disconnect to control panel and operator.
- .3 Provide separate switch located at each door to activate and de-activate door timer and photo eye controls.
- .4 Coordinate connection of door operation with street traffic light system in accordance with authority having jurisdiction.

### **3.4 INSTALLATION**

- .1 Securely install Products to ANSI/DASMA 102, and reviewed engineered Shop Drawings.
- .2 Install products straight, level, plumb and square.
- .3 Install products for long life under hard use.
- .4 Assemble structural elements by welding or by mechanical fasteners.
- .5 Field weld steel components to CSA W59.
- .6 Field weld aluminum components to CSA W59.2.
- .7 Isolate aluminum elements with bituminous coating in order to avoid direct contact with elements of a different metal.
- .8 Adequately brace tracks with track supports, bolted in place.
- .9 Install electrical components to ANSI/CAN/UL 325.
- .10 Install push button stations at door openings, same side as operators and adjacent to track.
- .11 Install additional push button stations for each door in Station Office 109.
- .12 Install traffic-control lights on each side of Apparatus Bay overhead doors, mounted at a height as directed by Consultant.
- .13 Mount photo eye controls at 510 mm above finished floor.
- .14 Provide fasteners, trims and other components required for mounting equipment.
- .15 Provide full flexible weatherstripping around door openings.

### **3.5 ADJUSTING**

- .1 Adjust doors to operate with manual ease.
- .2 Adjust doors to form a proper weatherseal when closed.

**3.6 FIELD QUALITY CONTROL**

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection, and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- .2 Manufacturer's field services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Obtain reports within three days of review and submit.

**3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .1 Repair damage to adjacent materials caused by Work of this Section.

**3.9 DEMONSTRATION**

- .1 Refer to Section 01 79 00.
- .2 Instruct Owner's personnel in proper operating and maintenance procedures.

**3.10 MAINTENANCE**

- .1 Inspect and lubricate doors monthly throughout Contract warranty period.
- .2 Upon request by Owner, level and adjust overhead doors that have become misaligned or no longer operate properly during Contract warranty period.

**3.11 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 92 00 - Joint Sealants.
- .2 Section 08 14 16 - Wood Doors.
- .3 Section 08 80 50 - Glazing.
- .4 Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 DAF 45-2003 (R2009), Designation System for Aluminum Finishes.
  - .2 AA ADM-2020, Aluminum Design Manual, 2020 Edition.
  - .3 Properties of Aluminum Alloys: Fatigue Data and the Effects of Temperature, Product Form, and Processing, 2008, published by ASM International.
- .2 Fenestration and Glazing Industry Alliance (FGIA)
  - .1 AAMA CW-10-15, Care and Handling of Architectural Aluminum from Shop to Site.
  - .2 AAMA CW-11-85, Design Wind Loads for Buildings and Boundary Layer Wind Tunnel Testing.
  - .3 AAMA CWM-19, Curtain Wall Manual.
  - .4 AAMA TIR-A1-04, Sound Control for Fenestration Products.
  - .5 AAMA TIR-A8-16, Structural Performance of Composite Thermal Barrier Framing Systems.
  - .6 AAMA 501-15, Methods of Test for Exterior Walls.
    - .1 AAMA 501.1-17, Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure.
    - .2 AAMA 501.5-07, Test Method for Thermal Cycling of Exterior Walls.
  - .7 AAMA 503-14, Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
  - .8 AAMA 609/610-15, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
  - .9 AAMA 611-20, Voluntary Specifications for Anodized Architectural Aluminum.
  - .10 AAMA 701/702-11, Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals.
  - .11 AAMA 1503-09, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
  - .12 AAMA 2604-22, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
  - .13 AAMA 2605-22, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

- .3 ASTM International (ASTM)
  - .1 ASTM A36/A36M-19, Specification for Carbon Structural Steel.
  - .2 ASTM A123/A123M-17, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
  - .4 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
  - .5 ASTM B209/B209M-21, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .6 ASTM B221-20, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .7 ASTM B429/B429M-20, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
  - .8 ASTM C864-05(2019), Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
  - .9 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
  - .10 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.
  - .11 ASTM D695-15, Standard Test Method for Compressive Properties of Rigid Plastics.
  - .12 ASTM D790-17, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - .13 ASTM D953-19, Standard Test Method for Pin-Bearing Strength of Plastics.
  - .14 ASTM D3846-08(2015), Standard Test Method for In-Plane Shear Strength of Reinforced Plastics.
  - .15 ASTM E283/E283M-19, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - .16 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.
  - .17 ASTM E413-16, Classification for Rating Sound Insulation.
  - .18 ASTM E547-00 (2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
  - .19 ASTM E783-02(2018), Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
  - .20 ASTM E1105-15, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .4 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB 1.40-97, Anticorrosive Structural Steel Alkyd Primer.
  - .2 CAN/CGSB 12.1-2017, Safety Glazing.
  - .3 CAN/CGSB 12.3-M91 (R2017), Flat, Clear Float Glass.
  - .4 CAN/CGSB 12.8-2017, Insulating Glass Units.
  - .5 CAN/CGSB 12.20-M89, Structural Design of Glass for Buildings.



- .5 CSA Group (CSA).
  - .1 AAMA/WDMA/CSA 101/I.S.2/A440-17 – NAFS, North American fenestration standard/Specification for windows, doors, and skylights.
  - .2 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .3 CSA G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles, Includes Update No. 1 (2020).
  - .4 CSA S136-16, North American specification for the design of cold-formed steel structural members.
  - .5 CSA S157-2017/S157.1-2017, Strength Design in Aluminum / Commentary on CSA S157-17, Strength Design in Aluminum.
  - .6 CSA W59.2-18, Welded Aluminum Construction.
  - .7 CAN/CSA Z91-17, Health and Safety Code for Suspended Equipment Operations.
- .6 Society for Protective Coatings (SSPC).
  - .1 Surface Preparation Guidelines:
    - .1 SSPC-SP COM Surface Preparation Commentary for Steel and Concrete Substrates.
    - .2 SSPC-PS Guide 12.00, Guide to Zinc-Rich Coating Systems.
  - .2 SSPC - Paint 20 Zinc Rich Coating.
  - .3 SSPC - Paint 25 Alkyd, Zinc Oxide Linseed Oil and Primer for Use Over Hand Cleaned Steel Type 1 and Type 2.

### 1.3 DESIGN RESPONSIBILITY

- .1 Drawings and details are diagrammatic and are intended to show design concept, configuration, components and arrangements; they are not intended to identify nor solve completely the problems of thermal and structural movements, air pressure equalization, air and vapour barriers, assembly framing, fixings and anchorages, moisture disposal, water penetration, orientation of walls, shading factors, size and shape of glazing, location of convectors, location of blinds, and problems at the glass line associated with glazing installation, movements, pressure fracture or thermal shock and weather seal.
- .2 The design, engineering, procurement, fabrication and erection of the curtain wall assemblies, as required to meet these performance specifications shall be the complete responsibility of the Contractor.

### 1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor, Consultant, installer, and manufacturer's representative in accordance with Section 01 31 19 – Project Meetings to:
  - .1 Verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements;
  - .2 Review location and alignment of vertical and horizontal elements as they relate to the aesthetic criteria indicated on the Drawings, and the technical requirements indicated on the shop drawings.
- .2 Coordination: Coordinate installation of system with work specified in other Sections to ensure proper placement and installation of vapour barrier, insulation and flashing in order that air, vapour and thermal barrier of building is intact and moisture will be diverted to the exterior, and as follows:

- .1 Coordinate installation of sealants so that ambient and surface temperatures are greater than 5°C from time of application until sealants have cured.
- .2 Coordinate connection of curtain wall system structural connections at floor slabs to vertical members.

## 1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's published product literature, specifications and datasheets for all products and materials incorporated into the Work of Contract.
- .3 Shop Drawings:
  - .1 OBC Importance Factor: post-disaster; the delegated design engineer (P.Eng.) shall design the Shop Drawings to suit post-disaster criteria and seismic Site Class D.
  - .2 The geotechnical engineer has recommended that the site be classified as "Site Class D" for structural design purposes in the absence of a site-specific dynamic analysis.
    - .1 Design, erect and install glazed aluminum framing systems to meet OBC requirements for Class D seismic conditions, or as otherwise determined by a professional engineer (P.Eng.) licensed to practice in the Province of Ontario based on OBC calculations.
  - .3 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
  - .4 Submit engineered shop drawings, signed and sealed (Engineer's Stamp) by the delegated design engineer, detailing fabrication and assembly of glazed aluminum curtain wall systems clearly indicating all construction details including; but not limited to, the following:
    - .1 Fully dimensioned layouts for positioning of secondary support members and anchorage of tie-back devices to structures;
    - .2 Large scale details of members and materials, of brackets and anchorage devices and of connection and jointing details;
    - .3 Fully dimensioned layouts for positioning of brackets and anchorage devices to structures;
    - .4 Dimensions, gauges, thicknesses;
    - .5 Type, size and spacing of fastening devices;
    - .6 Glazing details;
    - .7 Air/vapour barrier details, acoustic control details, aluminum alloy and temper designations, metal finishing specifications and other pertinent data and information;
    - .8 Internal drainage;
    - .9 Show details of connecting work of this section with work of adjacent sections.
- .4 Samples:
  - .1 Submit samples of materials for Consultant's verification of specified finishes including; but not limited to, the following:
    - .1 300 mm x 300 mm for sheets, plates and glass;
    - .2 300 mm long for extrusions and formed or rolled shapes;

- .3 300 mm long for tapes and gaskets;
  - .4 150 mm long for sealants;
  - .5 Samples shall fully represent physical and chemical properties, finish, and colours of materials to be supplied.
- .5 Information Submittals: Provide the following:
- .1 Delegated Design Submittals: Submit letters of commitment and compliance as follows:
    - .1 Provide Letter of Commitment in conjunction with shop drawings, signed and sealed by the professional engineer required by the Work of this Section indicating the following are designed to the intent of the Building Code:
      - .1 Post-Disaster Importance Factor.
      - .2 Seismic Site Class D criteria.
      - .3 Framing connections to building structure.
      - .4 Framing reinforcement.
      - .5 Deflection of members.
      - .6 Glass thickness as it relates to glass area.
      - .7 System SHGC values based on the framing used and insulating glass units installed.
    - .2 Provide Letter of Compliance, signed and sealed by the professional engineer required by the Work of this Section indicating that connections, reinforcement and deflection criteria, and glass thickness of installed system is in compliance with the intent of the applicable Building Code and reviewed shop drawings before declaration of Substantial Performance.
  - .2 Calculations:
    - .1 Submit complete design study calculations, certified by a professional engineer licensed to design structures and registered in the jurisdiction of the Place of the Work, including pertinent information affecting design, wind reactions, shading effects and failure probability for thermal glazing units, to Consultant as evidence of compliance with design criteria, prior to manufacture.
    - .2 Pressure equalized rain screen (PER) design: calculations to include the following:
      - .1 Pressure equalization during exposure to the design wind pressures and gusts;
      - .2 PER design provides pressure equalization of the cavity compartments within 0.5 seconds.
  - .3 Sealant Data:
    - .1 Submit product information on the sealants to be used, complete with all recommendations and installation instructions, including cleaning and priming procedures.
    - .2 Submit sealant manufacturer's test reports on adhesion to metal and glass production samples tested in accordance with ASTM C794, 7-day cure and 7-day water submersion, tensile strength at 100% elongation and bite size of sealants.

- .3 Submit sealant manufacturer's compatibility statement that all materials in contact with the sealants are compatible with the sealants in accordance with procedures of ASTM C1087.
- .6 Submit sealant manufacturer's verification that sealants are suitable for purposes intended.
- .7 Test Reports:
  - .1 Prior to commencement of the work of this Section, submit test reports showing compliance with specified performance characteristics and physical properties including air infiltration, water infiltration, structural performance and thermal cycling.
  - .2 Submit thermal simulation reports prepared by an NFRC certified modeller showing total system U-values. Provide reports for 2 representative areas of the Project as selected by the Consultant.
- .8 Closeout Submittals: Provide operation and maintenance data for incorporation into manual specified in Division 01 requirements and as follows:
  - .1 Submit data for cleaning of aluminum finishes and maintenance of structural silicone glazing system and operational hardware;
  - .2 Instruction for replacement of glass units (insulating and structural glass).

#### **1.6 QUALITY ASSURANCE**

- .1 Sole Source: to ensure compatibility, use the same manufacturer for exterior aluminum framing: exterior entrances, operable windows and curtain wall systems.
- .2 Qualifications: The firm producing and executing the Work of this Section shall have a minimum of 5 years' successful experience in the fabrication and erection of systems of similar sizes, shapes and finishes to the units required for this project and shall have ample facilities to produce, furnish and supply the units as required for installation without delay to the Work.
- .3 Delegated Design Professional: Retain a Professional Engineer (P.Eng.), licensed to practice in the Province of Ontario, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including, but not limited to, the following:
  - .1 Seal and signature to shop drawings and design submittals.
  - .2 Site review of installed components. P.Eng. required to perform at least one field inspection for their stamped shop drawings, and one more to confirm remedial action if deficiencies noted in first visit.

#### **1.7 MOCK-UP**

- .1 Construct mock-ups in accordance with Division 01 requirements.
- .2 Mock-up: Construct full size 3 x 3 m (10 x 10 ft) mock-up of vertical glazed aluminum curtain wall using proposed procedures, materials and quality of work where directed by Consultant and in accordance with Section 01 43 00 – Quality Assurance.
- .3 Include framing components, glass, and insulated infill panel.
- .4 Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
- .5 Purpose: To judge quality of work and material installation.
- .6 Allow Consultant minimum 24 hours prior to inspection of mock-up.

- .7 Test the mock-up in accordance with the requirements of FIELD QUALITY CONTROL in the presence of the Consultant. If any adjustments are required to installation procedures in order to pass these tests, record all procedures and provide a report detailing the methods used to pass the tests, which will then become the standard for the remainder of the curtain wall work.
- .8 Do not proceed with work prior to receipt of written acceptance of mock-up by Consultant.
- .9 When accepted, mock-up will demonstrate minimum standard of quality required for work of this Section.
- .10 Approved mock-up will remain part of finished work.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- .1 Comply with AAMA CW-10 for care and handling of all aluminum Products through the entire manufacturing, finishing, fabrication, delivery and installation phases.
- .2 Protect metal and metal finishes to prevent damage during fabrication, storage, shipping, handling and installation.
- .3 Protect insulating glass units during shipment. Repair or replace damaged components or units as required to meet Contract requirements, and replace any gas leakage during shipping to specified concentrations.
- .4 Deliver, handle and store units by methods approved by manufacturer. Store units at site on wood platforms raised above grade or in enclosures protected from elements and corrosive materials. Stack units vertically in manner to prevent racking. Do not remove from crates or other protective covering until ready for installation.

#### **1.9 SITE CONDITIONS**

- .1 Site Measurements: Verify dimensions of other construction by site measurements before fabrication and indicate measurements on shop drawings where aluminum curtain wall systems are indicated to fit to other construction.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating aluminum curtain wall without site measurements where site measurements cannot be made without delaying the Work, coordinated with other construction to ensure that actual dimensions correspond to established dimensions.
- .3 Ambient Conditions: Confirm installation requirements for ambient and surface temperatures of sealants with manufacturer and apply sealants when temperatures are greater than manufacturer's stated minimum from time of application until sealants have cured.

#### **1.10 WARRANTY**

- .1 Provide manufacturers written guarantee, signed and issued in the name of Owner, to replace the following items for defective material and workmanship for the time stated from date of Substantial Performance:
  - .1 Framing, panels and glazing: failure of performance requirements specified in Contract Documents; 5 years.
  - .2 Sealants, caulking: failure to maintain seal; 5 years.
  - .3 Structural silicone glazing; 20 years.
  - .4 Aluminum brake shapes: oil-canning and delamination; 5 years.
  - .5 Insulating glass units: 10 years.

- .2 Provide Warranty for aluminum windows to include in maintenance manuals as specified in Division 01.

## **Part 2 Products**

### **2.1 PERFORMANCE REQUIREMENTS – CURTAIN WALL**

- .1 Design structural support framing components to CAN/CSA S157 under direct supervision of a professional structural engineer (P.Eng.) experienced in design of this Work and licensed in Ontario.
- .2 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 OBC.
- .3 Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable codes.
- .4 Size glass units and glass dimensions to limits established in CAN/CGSB 12.20.
- .5 Mullion deflection (to ASTM E330):  $L/175$ , with full recovery of glazing materials.
- .6 Manufacturing Plant Air Infiltration, to ASTM E283:  $0.07 \text{ L/s}\cdot\text{m}^2$  at 300 Pa.
- .7 Manufacturing Plant Water Leakage, to ASTM E547: none, when measured at 720 Pa.
- .8 Ensure system is designed to accommodate the following without damage to components or deterioration of seals:
  - .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.
- .9 Ensure system allows for expansion and contraction within system components when temperature range is 85 degrees Celsius over 12-hour period without causing detrimental affect to system components.
- .10 Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.
- .11 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
  - .1 Position thermal insulation on exterior surface of air barrier and vapour retarder.
- .12 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.
- .13 Single Source: use one manufacturer's glazed aluminum framing system for the entire project, including swing doors.

### **2.2 STANDARD OF ACCEPTANCE SYSTEMS**

- .1 Curtain Wall / Exterior Screens:
  - .1 Kawneer 1600UT, or approved equivalent with matching dimensions and same or better physical properties and performance criteria.

- .2 Operable punch windows:
  - .1 Standard of Acceptance:
    - .1 Kawneer Trifab VersaGlaze 601UT, with fixed lite and operable awning lite; the operable awning shall be top-hinged outswing as shown on Drawings. Provide complete with interior removable framed insect screens at operable awning.
- .3 Exterior thermally-broken aluminum swing doors, complete with manufacturer's heavy-duty commercial accessories, pulls, hinges and hardware; door hardware per door hardware schedule and groups.
  - .1 Standard of Acceptance:
    - .1 Kawneer 350T Insulpour™, or approved equivalent with matching dimensions and same or better physical properties and performance criteria.
- .4 Interior Glazed Aluminum Framed Screens and Swing Doors:
  - .1 Glazed Aluminum Interior Framing – non-thermasl:
    - .1 Standard of Acceptance:
      - .1 Kawneer InFrame® Interior Framing System, or approved equivalent with matching dimensions, and same or better physical properties and performance criteria.
  - .2 Interior aluminum swing doors:
    - .1 Standard of Acceptance:
      - .1 Kawneer 190 Standard Entrances, or approved equivalent with matching dimensions, and same or better physical properties and performance criteria
  - .3 Doors shall be provided complete with manufacturer's heavy-duty commercial accessories, pulls, hinges and hardware; door hardware per door hardware schedule and groups.
  - .4 Non-thermal, aluminum frames and swing doors, single pane, centre glazed, 50 mm sightline, 152 mm depth.
  - .5 Where shown on Drawings, provide aluminum doorframes for wood doors; wood doors are specified per Section 08 14 16 - Wood Doors. Provide blocking and reinforcing for hardware and accessories as required.

## 2.3 MATERIALS

- .1 Aluminum materials:
  - .1 Extruded bars, rods, profiles, and tubes: In accordance with ASTM B221/B221M, and AA-6063-T5 or T6 temper, anodizing quality.
  - .2 Sheet and plate: to ASTM B209/B209M, anodizing quality, alloy and temper suitable for purpose and finish required, special hardness for flat panel application, re-squared saw cut edges, free from perceptible distortions, waves, twists, buckling or other deficiencies in appearance or performance.
    - .1 Panels, copings, soffits, sills, trims, closures and other such components shall be minimum 3 mm thick; 1.5 mm thickness may be used for flashings. Finish to match exterior curtain wall finish.

- .3 Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- .4 Aluminum extruded structural pipe and tubes: In accordance with ASTM B429, and AA6063-T6 temper, anodizing quality.
- .5 Structural Profiles: In accordance with ASTM B308/B308M, anodizing quality.
- .6 Aluminum welding: to CSA W59.2.
- .2 Steel: to CSA G40.20/G40.21, 300W hot dipped galvanized after fabrication to ASTM A653/A653M, minimum coating of 600 g/m<sup>2</sup> shapes to suit mullion sections.
- .3 Galvanizing, unless otherwise specified: hot dipped galvanizing to ASTM A123/A123M.
- .4 Stainless steel: to ASTM A167, Type 316; of one type throughout.
- .5 Welding materials: to CSA W59.
- .6 Welding electrodes: to CSA W48 Series.
- .7 Solder and flux: to ASTM B32, alloy composition 85 Tin/15 Zinc for aluminum. Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .8 Emulsified asphalt protective coating for metals: to ASTM D1187/D1187M.
- .9 Anchors: 3-way adjustable hot-dip galvanized cast iron.
- .10 Fasteners: to ASTM A167, stainless steel, type 316 as recommended by curtain wall manufacturer selected to prevent galvanic action with the components fastened, of suitable size to withstand imposed loads.
- .11 Anti-rotation spacers: manufacturer's extruded aluminum spacers with integral gaskets as required at frame transitions and termination points, including at dual-glazed framing to single-pane spandrel panel transitions.
- .12 Grout fill for anchor pockets: non-shrink Masterflow 713 Plus, by BASF, or SikaGrout 212, by Sika Canada.
- .13 Primers and Adhesives: as recommended by curtain wall manufacturer.
- .14 Thermal barrier: 1 inch (25 mm) separation between the interior and exterior metal members in a typical condition, while maintaining a continuous watertight seal. Thermal barrier assembly shall be tested to the thermal cycling requirements of ASTM E2692 and show no sign of degradation following the test.
- .1 Thermal separators (thermal break): extruded silicone compatible elastomer that provides for silicone adhesion, size to conform to extruded aluminum members and other locations as required, minimum tensile strength of 14 MPa (2000 psi) and Durometer A Hardness of 60 +/- 5.
- .15 Insulated Spandrel Panels
  - .1 Spandrel Glass: to Section 08 80 50.
  - .2 Back pan: Galvanized steel in accordance with ASTM A653/A653M, 0.91 mm base metal thickness, formed into a pan shape to fit into glazing throat with back of pan flush with inside face of back section.
  - .3 Insulation for back pans: CurtainRock 80 by Roxul Inc., or Fibrex Safing, held in place with manufacturer's standard fixing system to back face of back pan.
- .16 Concealed flashing: manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.



- .17 Transition membranes: full-length mechanically anchored, extruded silicone rubber transition membrane to perimeter of frame profile to provide continuous air/vapour retarder to adjacent wall construction, compatible with adjacent materials and systems.
  - .1 Standard of Acceptance:
    - .1 Dow Corning Silicone Transition Strip.
    - .2 GE UltraSpan UST Silicone Transition.
    - .3 Pecora XL-Span 100% Silicone Extruded Transition Membrane.
- .18 Gaskets: glazing gaskets shall be silicone-compatible EPDM to ASTM C864, with dimensional tolerances and durometer hardness and of suitable size and shape to meet the requirements of the specifications and their specific application, designed to remain flexible at low temperatures, and provides for silicone adhesion; heat-resistant where required due to proximity of heating units.
- .19 Primer for ferrous metals: CISC/CPMA 2-75.
- .20 Zinc chromate primer, by PPG Industries, Inc. or similar.
- .21 Touch-up primer for galvanized steel: organic zinc rich primer, by Sherwin Williams Company of Canada Ltd. or similar.
- .22 Insulation for miscellaneous voids and cavities: Rockwool Curtainrock®, by Rockwool, or approved equivalent, friction fit, or held in place by miscellaneous metal angle or sheet metal flashing, as required.
- .23 Flexible flashing, flexible air/vapour retarder:
  - .1 Flashing as recommended by the curtain wall manufacturer, compatible with adjacent materials and systems.
  - .2 Adhesive, tapes, primers and sealant: as recommended by the flexible flashing manufacturer.
- .24 Sheet metal air/vapour barrier to be bonded to glazing frame and extended behind mounting frame. Seal to maintain continuity of seal. Install flexible flashing with continuous metal retaining strip to lap to interior wall assembly.
  - .1 Sheet metal for metal air/vapour barriers and air seals: ASTM A653 / A853M, minimum 1 mm sheet steel, galvanized, stretcher-levelled, minimum coating weight 380 g/m<sup>2</sup>.
- .25 Sealants, including primer, joint filler: as specified in section 07 92 00, augmented as follows:
  - .1 Sealants used in structural joints shall have adequate strength to retain insulating units to the metal framing or each other under design conditions.
  - .2 Sealants shall be from the same manufacturer for all work of this Section.
  - .3 Materials used in the work shall be resistant to rodents, vermin, mildew, fungus and algae.
- .26 Glass and Glazing: to Section 08 80 50 – Glazing.
- .27 Fire Safety Materials: to Section 07 84 00 – Firestopping and Smoke Seals.
- .28 Flashing: matching aluminum flashing as recommended by manufacturer, and as follows:
  - .1 Flashing: roll formed aluminum, 0.019" thick, mill finish.
  - .2 Aluminum sheet to conform to Federal Specification QQ-A-359, Alloy 3003.

- .29 Extruded aluminum angle closures at junction of curtain wall mullions and interior wall ends and steel columns. Secure with concealed fasteners. Colour to match curtain wall. Refer to plan details on Drawings.

## **2.4 ALUMINUM ENTRANCES**

- .1 Aluminum Extrusions: Alloy and temper recommended by sliding aluminum-framed glass door manufacturer for strength, corrosion resistance, and application of required finish and not less than 2.3 mm wall thickness at any location for the main frame and sash members.
- .2 Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with sliding aluminum-framed glass door members, trim hardware, anchors, and other components.
- .3 Anchors, Clips, and Accessories: Aluminum or nonmagnetic stainless steel; provide sufficient strength to withstand design pressure indicated.
- .4 Reinforcing Members: Aluminum or nonmagnetic stainless steel; provide sufficient strength to withstand design pressure indicated.
- .5 Weather Seals: Provide weather stripping with integral barrier fin or fins of semi rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
- .6 Major portions of the door members to be 3.2 mm nominal in thickness and glazing molding to be 1.3 mm thick.
- .7 Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
- .8 Provide adjustable glass jacks to center the glass in the door opening.

## **2.5 FABRICATION – GENERAL**

- .1 Do not start fabrication until samples, shop and erection drawings have been reviewed.
- .2 Insofar as practical, execute fitting and assembly in the shop with the various parts or assemblies ready for erection at the building site.
- .3 Where possible, take field measurements and levels required to verify or supplement those shown on the drawings for the proper layout and installation of the work. Coordinate dimensional tolerances in adjacent building elements and confirm prior to the commencement of the Work.
- .4 Weld aluminum, where required, with inert metal arc equipment. Welders to qualify according to CSA W47.2. Make exposed welds continuous and flush with adjacent surface. Do not mar surface finishes with welds in back of exposed aluminum. Do not deform the exposed metal and finish way by welding.
- .5 Weld steel, where required, to CSA W59. Welded joints to be of adequate strength and durability with jointing tight and flush. Welders to be fully approved by the Canadian Welding Bureau and to comply with CSA W47.1. Where it is necessary to weld components already galvanized, remove galvanizing for 50 mm around weld.
- .6 If curtain wall framing extends up to top of roof parapets, the headrail and glazing cap shall be reinforced to withstand force from window cleaner's suspension chair ropes, which will extend over the top of the parapet and down the face of the building.
- .7 Make provisions in doors and frames to suit requirements of electrically operated hardware and security devices, as applicable, provided under other trades or sections. Blank, drill, reinforce and tap to receive hardware, security and electrical devices. Provide removable plates or knockouts for electrical contacts. Provide fish wires as required.

- .8 Equip perimeter framing with factory installed air and vapour barrier material as required for sealing to building air and vapour barrier, and as follows:
  - .1 Material: identical to, or compatible with, building air barrier and vapour retarder materials to provide required air tightness and vapour diffusion control throughout exterior envelope assembly.
  - .2 Material width: adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder from interior.

## **2.6 FABRICATION – FRAMING MEMBERS**

- .1 Fabricate members to the profiles shown on the drawings. Wall thickness of extrusions to be as required to meet the design requirements. Frames that are to receive insulating glass units shall have a continuous thermal break.
- .2 Accurately machine file and fit, and rigidly frame together joints, corners and mitres. Match components carefully to produce perfect continuity of line and design. Make exterior joints watertight and interior joints airtight in accordance with specified allowances. Metal in contact to have hairline joints. Locations of exposed joints to be subject to the approval of the Consultant.
- .3 Sill Trim: Provide continuous extruded "U" trim to inside of bottom rail at each level with provision for receiving steel base and convector covers, as detailed.
- .4 Reinforce frames and assemblies by concealed means as necessary to meet the specified design requirements and as shown. Reinforcing to be hot-rolled mild steel and be securely anchored to horizontal and vertical members by approved positive mechanical means.
- .5 Seal hairline joints at junctions of frame members. Gun-inject sealant from inside ensuring a continuous seal of the joint. Ensure that bead in the glazing space does not impair seating of glazing materials. Remove excess sealant that is forced onto face of frame assembly.
- .6 Location of joints and pressure equalizing drain vents to be subject to consultant's acceptance.
- .7 Provide sheet continuous air/vapour barrier between framing and building structure. Overlap corner joints. Apply barriers and retain with continuous aluminum or galvanized steel plates or bars and non-corrosive mechanical fasteners. Where indicated, fill void between frame and other building components solid with foamed in place polyurethane foam insulation.
- .8 Develop drainage holes with moisture path to exterior.
- .9 Prepare components to receive anchor devices. Fabricate anchorage items.
- .10 Arrange fasteners, attachments, and jointing to ensure concealment from view.
- .11 Cope, notch and drill to provide minimum tolerance throughout system and to fit with hairline joints.
- .12 Conceal interconnecting members and fastenings in completed assembly. Provide pressure-equalizing holes in members and condensation drains.
- .13 Framing members and associated sealing shall combine to form airtight vapour barrier for entire interior skin of curtain wall system. Cooperate and coordinate with other sections to ensure continuous thermal and air barrier seal at interfaces with adjacent materials.
- .14 Provide for vertical expansions and construction joints as necessary and install air cut-offs in continuous vertical members to prevent stack effect of enclosed air columns.

- .15 Jointing and intersections of metals shall be accurately cut, fitted to a tolerance of 0.8 mm, in true planes with adequate concealed beads where required.
- .16 Fabricate expansions joints between mullion sections with formed extruded aluminum internal sleeve sections, secure to permit joint function and maintain true alignment of sections.
- .17 Fabricate sections to accommodate and interface with work of other trades by means of rabbets, interlocks, miscellaneous angles, trim and filler sections as required.
- .18 Fabricate mullions not less than one storey height with fully fashioned expansion joints adequate for expansion and contraction required. Avoid chimney effect inside mullions by stopping voids at each floor level with packing consisting of rigid insulation.
- .19 Brake form parapet caps and sills out of 3 mm thick aluminum sheet.
- .20 Reinforce mullions with structural steel sections where required with adequate anchorage to structure.
- .21 Provide internal reinforcement in horizontal window mullions to satisfy wind loads and to maintain rigidity.
- .22 Perform fitting and assembly of component parts in shop insofar as practicable. Work that cannot be permanently shop assembled shall be fitted, assembled, marked and disassembled to assure proper fitting in field. Identify shop assembled components on shop drawings for location and erection at site.
- .23 Isolate aluminum in contact with other metals, masonry, concrete, plaster or mortar to prevent corrosion.
- .24 Verify wall openings and adjoining air and vapour seal materials are ready to receive work of this section.
- .25 Beginning installation means acceptance of site conditions.
- .26 Provide airtight vapour seals in curtain wall framing.

## **2.7 FABRICATION – ENTRANCES**

- .1 Fabricate aluminum-framed glass entrance doors in sizes indicated. Include a complete system for assembling components and anchoring doors. Comply OBC criteria.
- .2 Door hardware and keying: in accordance with Door Hardware Schedule. Additional miscellaneous hardware shall be manufacturer's heavy-duty commercial quality accessories and hardware as required for a complete installation.
- .3 Fabricate aluminum-framed glass doors that are re-glazable without dismantling perimeter framing.
- .4 Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" (29 mm) long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord.
- .5 Accurately fit and secure joints and corners. Make joints hairline in appearance.
- .6 Prepare components with internal reinforcement for door hardware.
- .7 Arrange fasteners and attachments to conceal from view.
- .8 Door hardware to be supplied by door hardware contractor under the door hardware Section, to be installed by curtainwall contractor. Prepare curtainwall framing for installation of all door hardware and accessories. Refer to Door Schedule and door hardware schedule and groups.
- .9 Provide all hardware of each type from one manufacturer.

- .10 Keying: in accordance with Division 08 door hardware schedule and groups; provide removable / exchangeable construction cores and 20 extra keys each lock for construction cores.

## **2.8 FABRICATION – SPANDREL PANELS**

- .1 Refer to Drawings for size, type and location of glass spandrel panels.
- .2 Spandrels to have insulated backup panels, complete with 75 mm thick insulation consisting of two layers. Secure insulation to metal liner with adhesive and "spindle" clips with black retainer discs, minimum two per board.
- .3 First layer of insulation to be 50 mm thick impaled on clips and secured with retainer discs. Second layer to be black-faced, secured to first with adhesive, uniformly spread over opposing faces. Align panels symmetrically with joints in line and tight together. Cut off ends of spindles just above discs. It is imperative that joints are tight so that edges do not show, if misaligned, caulk with black sealant. Similarly caulk perimeter edges. Appearance from outside shall be a consistent black colour.
- .4 Fabricate liner panel from not less than 22-gauge galvanized sheet steel with airtight seams, brake formed at the edges. Isolate dissimilar metal surfaces using isolation coating. Reinforce with galvanized steel sections as required for rigidity and to meet design criteria, and to eliminate noises due to thermal and air pressure changes.
- .5 Seal perimeter of liner panels with non-permeable sealant to maintain vapour barrier. Install weatherseal, rain deterrent and vent where detailed and required.
- .6 Reinforce liner panels where necessary to prevent undue deflection.
- .7 Provide sloping sills with high backs to terminate curtain wall system at bottom. Brake form to detailed profiles. Provide flashing as required to cover edge of concrete of finish and colour matching framing.
- .8 Fabricate panels in manner to maintain complete thermal and vapour barrier seal at inner panel, yet to ensure moisture is drained to exterior.
- .9 Form aluminum flashing, parapet coping and cap flashing as detailed and to locations indicated. Prevent damage by window washing equipment, ladders, etc., by reinforcing edges of copings and caps.
- .10 Provide sound baffles within spandrels to reduce noise transmission vertically between floors.

## **2.9 FABRICATION – FLASHING AND ACCESSORIES**

- .1 Panels, copings, soffits, sills, trims, closures and other such components shall be minimum 3 mm thick; 1.3 mm thickness may be used for flashings. Finish to match exterior curtain wall finish.
  - .1 Fabricate and install 3 mm thick formed aluminum prefinished panels to profiles indicated.
- .2 Provide sloping sills with high backs to terminate curtain wall system at bottom. Brake form to detailed profiles.
- .3 Form aluminum flashing, parapet coping and cap flashing as detailed and to locations indicated. Prevent damage by window washing equipment, ladders, etc., by reinforcing edges of copings and caps.

## **2.10 FINISHES**

- .1 Aluminum: anodic coating, to AA DAF-45 and AAMA 611 for anodized architectural aluminum, in accordance with the Drawings, and as follows:
  - .1 Coloured Anodized Finish: Exposed aluminum surfaces to Aluminum Association (AA) Architectural Class I (0.7 mils minimum / 18 microns), AA-M12C22A44, colour: black (except as noted otherwise on Drawings)
    - .1 For interior screens, provide (AA) Architectural Class II (0.4 mils minimum / 10 microns), AA-M12C22A44, colour: black (except red door locations).
  - .2 Unexposed aluminum: Mill finish.
- .2 Doors scheduled for Red Doors and Frames:
  - .1 Three-Coat PVDF Coating: AA-C12 Chemical Finish, cleaned with inhibited chemicals; C40 Chemical Finish, conversion coating; R1x Organic Coating, manufacturer's standard two coat, thermo-cured system consisting of specially formulated inhibitive primer, fluoropolymer colour coat, and clear fluoropolymer topcoat, with both colour coat and clear topcoat containing not less than 70% PVDF resin by weight; prepare, pre-treat, and apply coating to exposed metal surfaces in accordance with AAMA 2605 and with coating and resin manufacturers' published instructions.
  - .2 Colour: Red, specific red colour/hue as selected and confirmed by Consultant.
  - .3 Locations: doors 116b and 116c, including transoms.
- .3 Steel exposed to exterior conditions that is on cold-in-winter side of air/vapour barrier, but not exposed to view, shall be blast cleaned and hot dip galvanized in accordance with ASTM A123/A123M. Thread dimensions to be such that nuts will thread over bolts without re-threading or chasing galvanized threads.
- .4 Galvanize after fabrication. Follow standard precautions to avoid making the base metal brittle by over pickling, overheating or during galvanizing.
- .5 Colour appearance to be uniform with no variations detectable at 1525 mm under natural lighting.
- .6 Shop and touch-up primer for steel components: SSPC 25 Paint red oxide.
- .7 Touch-up primer for galvanized steel surfaces: SSPC 20 Paint zinc rich.
- .8 Concealed steel items: galvanized in accordance with ASTM A12/A123M.
- .9 Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Inspect Work and conditions affecting the Work of this Section. Proceed only after deficiencies have been corrected.
- .2 Ensure that all flashings built in or provided by others integrate with system to divert moisture to exterior.
- .3 Ensure that all anchor blocks or inserts required to receive system are correctly located and installed.

- .4 Ensure that all anchors and setting or installing components provided by this Section for installation are properly located and installed.
- .5 Ensure that building air and vapour retarding membranes can be sealed to window units to maintain system integrity. Coordinate with materials installation specified in Section 07 27 14 - Air and Vapour Control Layers.

### **3.2 PREPARATION**

- .1 Coordinate dimensions, tolerances, and method of attachment with other work.
- .2 Supply anchorage devices and inserts to the appropriate sections where required for building in or casting-in-place and instruct as to proper location and position. Anchors shall have three-way adjustments.
- .3 Remove dust and other loose material from openings.
- .4 Verify that surfaces are ready to receive work and floor-to-floor dimensions are as indicated on shop drawings.

### **3.3 INSTALLATION**

- .1 Compliance: comply with AAMA CWM-19 recommendations, and manufacturer's published installation instructions, standard details as applicable, and data sheets.
- .2 Use only concealed fasteners, manufacturer's recommended aluminum fasteners or type 316 stainless steel, unless otherwise specified.
- .3 Erect all work plumb and true and in proper alignment and relationship to established lines and grades.
- .4 Devices for anchoring the frame assemblies shall have sufficient adjustment to permit correct and accurate alignment. After alignment, positively secure anchorage devices to prevent movement other than those designed for expansion and contraction. Take into consideration climatic conditions prevailing at time of installation.
- .5 Perform welding and drilling of concrete as required to install fixings. Repair, concrete chipped by drilling or fixing operations.
- .6 Group components with shop applied finishes so that those that relate most closely to one another, with regard to colour and appearance, shall be installed adjacent to each other.
- .7 Coordinate work of this section with, and provide connection for, compartmentalization of air spaces provided under other sections.
- .8 Provide thermal insulation and air/vapour barriers compatible and continuous with adjacent thermal and air/vapour barrier systems.
- .9 Apply continuous butyl sealing tape between sheets at lap and between steel and other materials. Screw sheets to each other and metal framing with type 316 stainless steel sheet metal screws, 150 mm o.c. maximum. Continuously seal perimeter of panels with tape and sealant. Place type 316 stainless steel washers over rubber washers under screw heads and cover with sealant to make fastenings air and vapour tight.
- .10 Seal joints of metal, apertures and protrusions of any kind with specified sealant to produce homogeneous air/vapour barrier seal. Joints shall be air, water and weathertight.
- .11 Apply silicone sealant and foam rubber joint plugs (end dams) as required at frame corners to fill and seal the joinery.

- .12 Supply and install flexible, continuous gasket air/vapour barrier seals between work of this section and adjacent construction, and at deflection and expansion connections, where required. Prime substrates, apply gaskets to framing and to concrete and masonry with adhesive and retain with continuous aluminum or stainless-steel plates or bars and non-corrosive mechanical fasteners. Ensure a continuous permanent seal at joints.
- .13 Provide airtight seals at penetrations in air/vapour barriers.
- .14 Apply insulation to the cold in winter side of air/vapour barriers. Ensure tight butt joints.
- .15 Adhere stick clips to metal air/vapour barriers at 300 mm o.c. both ways. As an alternative, gun weld pins to metal substrates in lieu of stick clips, provided clips do not easily break off and weld burn-through does not occur.
- .16 Support adhesive-applied clips in place until adhesive has set.
- .17 Isolate metal air/vapour barriers with thermal breaks and spacers.
- .18 Locate vapour barrier on the warm-in-winter side of the insulation.
- .19 Ensure a uniform, continuous thermal and vapour barrier effect. Where adjacent insulation and vapour barriers are to be provided under other sections, coordinate the work such that thermal and vapour barrier continuity is achieved. Ensure compatibility with adjacent thermal and air/vapour barrier systems. Ensure compatibility between tapes, sealants and air/vapour barriers.
- .20 Cut insulation as required and fit snugly to penetrations, obstructions, openings and corners. Butt insulation boards tightly. Cut out back of board insulation as required to accommodate substrate irregularities and build up over cut out areas on the other side as required to ensure thermal barrier uniformity unless otherwise approved.
- .21 Install insulation to thicknesses shown on the Drawings, or as required to achieve continuity of thermal insulation performance.
- .22 Press insulation boards firmly to barrier or substrate impaling them on clips without bending clips. Butt insulation boards tightly. Install retainers to clips.
- .23 Fill irregular shaped voids within assemblies with fibrous packing insulation to maintain continuity of thermal barrier.
- .24 Protect exterior finished surfaces by installing snap-on caps only when building is closed in, and when the possibility of damage due to construction has been minimized, to the approval of the Consultant.
- .25 Provide structural steel framing and supports required to support work of this Section unless indicated to be supplied under other Sections. Provide structural steel support or reinforcement for anchorage of railings.
- .26 Supply and install galvanized formed steel coping supports.
- .27 Supply and install sheet waterproofing membrane at copings and parapets as indicated. Lap, adhere, and seal joints in membrane in accordance with recommendations of the membrane manufacturer to provide a watertight, continuous membrane.
- .28 Gun-apply three continuous beads of sealant under extruded aluminum thresholds. Make bead diameter sufficient to ensure a full width seal. Remove excess sealant.
- .29 Swing Doors and Frames:
  - .1 Comply with Drawings and manufacturer's printed installation instructions for installing aluminum swing entrance doors, hardware, accessories, and other components.



- .2 Provide 20 mm wide x 115 mm deep aluminum sub-frame at door jambs within curtain wall at door openings.
- .3 Coordinate with electrical for power connection and wiring to automatic door operator and controls, security devices and other work to be incorporated.
- .4 Install aluminum swing entrance doors level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- .5 Set sill threshold in bed of sealant, as indicated, for weather tight construction.
- .6 Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### **3.4 ERECTION TOLERANCES**

- .1 Design and install curtain wall to accommodate tolerances of related work not included in this section. This requirement is in addition to building structure movements and deflections.
- .2 Fabricate components to provide a plumb, square, level and true installation, and to accommodate allowable tolerances for work of other sections upon which work of this section depends.
- .3 Erection tolerances for frame assemblies relate to the structural grid of the building, and apply to each individual assembly as follows:
  - .1 Vertical position: +3 mm;
  - .2 Horizontal position: +3 mm;
  - .3 Deviation from plumb: 3 mm maximum each plane;
  - .4 Racking of face: 6 mm maximum;
  - .5 Racking in elevation: Nil;
  - .6 Offset from true alignment between two identical members abutting end to end in line: 0.8 mm;
  - .7 Tolerances shall not be accumulative;
  - .8 Erection tolerances for operable elements: consistent with smooth operation and weatherproof performance.

### **3.5 FOAMED-IN-PLACE INSULATION**

- .1 Maintain Continuity of Thermal Performance: Install between aluminum framing and rough openings at exterior walls, at perimeter joints and penetrations at curtainwall, and where indicated: to Section 07 21 19.19 - Foam-in-Place Insulation.

### **3.6 COVERS, CLOSURES, AND TRIM**

- .1 Provide copings, covers, closures, and trim as indicated and as required to provide complete and finished installation.
- .2 Use concealed fastenings.
- .3 Fabricate aluminum components in largest practical lengths. Where joints are required, provide flush slip joints at exterior components and flush hairline joints at interior components. Unless otherwise indicated, locate joints to align with adjacent mullions and as directed by Consultant. All exterior joints to have suitable backplates and be sealed watertight.

### **3.7 FIELD GLAZING**

- .1 Install glass and insulating glass units to Section 08 80 50 – Glazing.

### **3.8 SEALANTS**

- .1 General: Seal joints between frame assemblies and adjacent construction except where specified to be done under other sections, and within glazed assemblies where required to maintain water tightness and integrity of air/vapour barrier. Seal junctions in sheet metal air/vapour barriers and between air/vapour barriers and adjacent construction.
- .2 Preparation:
  - .1 Ensure that joint conditions are suitable for the materials to be installed.
  - .2 Ensure that surfaces to be sealed are sound, dry, free from dirt, water, frost, loose scale, corrosion, or other contaminants which may adversely affect the performance of the sealant materials. Remove protective oil coatings and other oil or grease films.
  - .3 Perform cleaning to the extent required to achieve acceptable joint surfaces.
  - .4 Protect cleaned and primed surfaces from further contamination by oil, dust, rain, condensation and other materials detrimental to sealant bonding strength. Re clean and re prime contaminated surfaces.
  - .5 Install joint filler strips as backup for sealant to provide optimum joint profile, but not less than 6 mm depth of sealant bead. Provide bond breaker tapes where required.
  - .6 Mask areas adjacent to the joints to prevent contamination of adjacent surfaces. Remove masking promptly after the joint has been completed.
  - .7 If recommended by the manufacturer of the sealant materials, prime joints to prevent staining, or to assist the bond.
  - .8 Apply primer with a brush which will permit all joint surfaces to be primed. Perform priming immediately before installation of sealant.
- .3 Installation:
  - .1 Install structural silicone in accordance with manufacturer's installation instructions and data sheets.
  - .2 Obtain approval from the sealant manufacturer for the priming, cleaning and application techniques at commencement of the sealant installation.
  - .3 Before sealant installation is commenced, test the sealant for adhesion to substrates.
  - .4 Install materials in compliance with the recommendations of their manufacturers.
  - .5 Do not exceed shelf life and pot life of materials, nor installation times, as stated by the manufacturer. Ensure sealant manufacturer's on-site quality control procedures are maintained.
  - .6 Be familiar with the work life of the sealant to be used. Do not mix multiple component materials until required for use.
  - .7 Mix sealants thoroughly with a mechanical mixer without mixing air into the materials. Continue mixing until the material is a uniform colour and free from streaks of unmixed material.
  - .8 Before any sealing is commenced, test the materials for indications of staining or poor adhesion.
  - .9 Sealants gun grade or knife grade consistency to suit joint condition. Use gun nozzles of the proper sizes to suit the joints and the sealant material.

- .10 Install sealant with pressure operated guns.
- .11 Use sufficient pressure to fill all voids and joints full. Sealants shall bond to all sides of joint except where filler or bond breaker material is used. Where filler or bond break material is used, sealant shall bond to both sides of joints and shall not adhere to the filler or bond break material.
- .12 Ensure that correct sealant depth is maintained. Superficial painting with a skin bead will not be accepted.
- .13 Sealant installations shall be a full bead free from air pockets and embedded impurities and having smooth surfaces, free from ridges, wrinkles and sags.
- .14 After joints have been completely filled, tool them neatly to a slightly concave surface.
- .15 If joints are masked, remove masking immediately after tooling and before sealants begin to cure.
- .16 Install exposed structural silicone sealants at glazing so that top surfaces of the beads are formed to drain water away from the glass.
- .17 Clean excess sealants from glass and framing surfaces immediately after installation.
- .18 Cover all fasteners penetrating the air/vapour barriers with sealant.
- .19 Immediately clean adjacent surfaces that have been soiled and leave work in a neat, clean condition. Remove excess materials and droppings using recommended cleaners and solvents.

### **3.9 FIELD QUALITY CONTROL**

- .1 Field Tests: conducted by Owner's third-party testing agency. Consultant will select portions of the installation to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

### **3.10 ADJUSTING**

- .1 Adjust operating entrances, hardware and accessories for a tight fit at contact points and weather stripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.
- .2 Replace defective materials and materials damaged due to faulty installation, careless handling or other causes resulting from work of this section.
- .3 Upon completion of the work and just prior to final review, or at a time as directed, inspect units for damage and correct same immediately.
- .4 Test and adjust hardware and replace or repair faulty items.
- .5 Adjust weather-stripping to leave each opening unit in its most watertight position.
- .6 Test operable elements and ensure easy and smooth operation.

### **3.11 CLEANING AND PROTECTION**

- .1 Cleaning of aluminum components shall be to AAMA 609.
- .2 Remove protective material from pre-finished aluminum surfaces, interior and exterior.

- .3 Remove, as work progresses, corrosive and foreign materials that may set or become difficult to remove at time of final cleaning or that may damage members. Inspect minimum monthly to ensure cleanliness.
- .4 Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- .5 Wash exposed surfaces with a pre-approved cleaning solution approved by manufacturers of glass and aluminum. Take care to remove dirt from corners. Wipe surfaces clean.
- .6 Select, apply and maintain cleaning and protective methods to ensure finishes will not become uneven or impaired as a result of unequal exposure to light and weathering conditions.
- .7 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .8 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .9 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .10 Cleaning shall include the interior/exterior surfaces of materials installed under this section.
- .11 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
- .12 Upon completion of the work of this section, remove debris, equipment and excess material resulting from the work of this section from the site.
- .13 Provide the Owner with instructions for proper methods and materials to be used in maintenance cleaning of finished surfaces.
- .14 Protect finished Work from damage.

**3.12 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 14 - Metal Doors and Frames.
- .2 Section 08 14 16 - Wood Doors.
- .3 Section 08 36 40 - Glazed Overhead Doors.
- .4 Section 08 44 13 - Glazed Aluminum Framing Systems.

**1.2 REFERENCES**

- .1 Builders Hardware Manufacturers Association (BHMA)
  - .1 Directory of Certified Products.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
  - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
- .3 CSA Group (CSA)
  - .1 CSA/ASC B651:23, Accessible design for the built environment.
- .4 Door and Hardware Institute (DHI)
  - .1 Sequence and Format for the Hardware Group Schedule.
- .5 International Code Council (ICC)
  - .1 ICC A117.1-209, Standard for Accessible and Usable Buildings and Facilities.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings: prior to ordering Products or commencing work on site, convene pre-installation meeting in accordance with Section 01 31 19 - Project Meetings, in order to accomplish the following:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building trades.
  - .4 Identify Owner's keying requirements, and any special requirements resulting from Owner's purchasing and maintenance policies and procedures.

**1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and technical datasheets for each hardware product supplied to the Project for installation.
- .3 Samples:
  - .1 Submit one sample of each type of type of hardware product for review and verification.
  - .2 Identify each sample by label indicating applicable door hardware group, hardware type, brand name and number, and finish.
  - .3 After approval, samples will be returned for incorporation in the Work.

- .4 Door Hardware Schedule:
  - .1 Submit a Door / Hardware Index (a schedule that links each door by number to its corresponding hardware group), coordinated with the Drawings (use the same door numbers as used on the Drawings).
  - .2 For each Door Hardware Group, identify all hardware to be installed at door and frame, including makes, models, materials, functions, sizes, finishes and other pertinent information.
  - .3 Submit an individual drawing in CAD format depicting arrangement of access control and security components, conduit, and cabling.
- .5 Keying Schedule:
  - .1 Submit keying schedule prepared by or under the supervision of qualified Architectural Hardware Consultant (AHC), detailing Owner's final keying instructions for locks, including schematic keying diagram and index each key set to unique door designations.
- .6 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.
- .7 Closeout Submittals, to Section 01 78 00 - Closeout Submittals:
  - .1 Provide operation and maintenance data for door closers, locksets, door holders, electrified hardware and fire exit hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.5 MAINTENANCE MATERIAL**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Supply two sets of wrenches for door closers, locksets, and fire exit hardware.

## **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .2 Storage and Protection:
  - .1 Store finishing hardware in locked, clean and dry area.

## **1.8 WARRANTY**

- .1 Provide written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
- .2 Failures include, but are not limited to, the following:
  - .1 Structural failures including excessive deflection, cracking, or breakage.

- .2 Faulty operation of operators and door hardware.
- .3 Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- .3 Warranty Period: from date of Substantial Performance, and as follows:

Hardware Type	Warranty Term
Locks, latches and cylinders	2 years
Closers	10 years
Hinges	Lifetime
Panics	3 years
Miscellaneous	2 years
Electrical Hardware:	2 years

## Part 2 Products

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- .1 Minimum Hardware Quality Required: to BHMA Grade 2 or better.
- .2 Work of this specification Section shall meet or exceed the requirements published in the following BHMA standards:
  - .1 Builders Hardware Manufacturers Association (BHMA)
    - .1 BHMA A156.1-2021, Butts and Hinges.
    - .2 BHMA A156.2-2022, Locks and Latches.
    - .3 BHMA A156.3-2025, Exit Devices.
    - .4 BHMA A156.4-2024, Door Closers and Pivots.
    - .5 BHMA A156.5-2020, Cylinders and Input Devices for Locks.
    - .6 BHMA A156.6-2021, Architectural Door Trim.
    - .7 BHMA A156.7-2022, Hinge Templates.
    - .8 BHMA A156.8-2021, Overhead Stops and Holders.
    - .9 BHMA A156.10-2024, Power Operated Pedestrian Doors.
    - .10 BHMA A156.12-2022, Interconnected Locks.
    - .11 BHMA A156.13-2022, Mortise Locks.
    - .12 BHMA A156.14-2024, Sliding and Folding Doors.
    - .13 BHMA A156.15-2021, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
    - .14 BHMA A156.16-2023, Auxiliary Hardware.
    - .15 BHMA A156.17-2025, Self-Closing Hinges and Pivots.
    - .16 BHMA A156.18-2020, Materials and Finishes.
    - .17 BHMA A156.19-2019, Power Assist and Low Energy Power Operated Swinging Doors.
    - .18 BHMA A156.21-2025, Thresholds.
    - .19 BHMA A156.26-2021, Continuous Hinges.
    - .20 Other BHMA standards, most recent published editions, as required to address products specified under Door / Hardware Index and Door Hardware Groups.

## **2.2 MATERIALS**

- .1 Use one manufacturer's products only for similar items.
- .2 The product numbers listed in Schedules are to be used as the standard of acceptance for all items. Other manufacturer's products will be considered provided they meet or exceed the performance, grade, quality, function, weight, design and finish of the specified product, and requests for approval are approved by the Consultant in writing through issued addenda 7-days prior to tender closing.

## **2.3 DOOR HARDWARE**

- .1 Door Hardware: supply and install door hardware as per Drawings and as per door hardware schedule. If an item is not specified that in the installer's opinion and trade experience would be advisable, notify Consultant and obtain written direction before ordering Products.

## **2.4 FASTENERS**

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

## **2.5 KEYING**

- .1 Meet with the Owner to finalize keying requirements and obtain keying instructions in writing. Interior locks and cylinders shall be furnished to Owner's master key system.
- .2 Provide temporary lost ball construction keying system during construction period.
- .3 Permanent cylinders to be keyed by factory, combined in sets or subsets, master keyed or great grand master keyed, as directed by Owner. Permanent keys, key blanks and cylinders are to be stamped with the keyset symbol for identification. Stamp cylinders with concealed visual keying for added security. These visual key control marks or codes will not include the actual key cuts. Furnish the following to Owner.
- .4 Provide keys in duplicate for every lock in this Contract.
- .5 Provide three masterkeys for each MK or GMK group.
- .6 Stamp keying code numbers on keys and cylinders.
- .7 Provide construction keying as required.
- .8 Provide all permanent cores and keys to Owner.
- .9 Key Control Cabinet:
  - .1 Wall Mounted Cabinet: Cabinet with hinged-panel door equipped with key holding panels and pin-tumbler cylinder door lock.



**Part 3 Execution**

**3.1 COMPLIANCE**

- .1 Comply with manufacturer's published installation instructions, data sheets, standard details, and specifications.
- .2 Furnish manufacturer's instructions and templates as required for preparation of work to receive hardware, as per the following Sections:
  - .1 Section 08 11 14 - Metal Doors and Frames.
  - .2 Section 08 14 16 - Wood Doors.
  - .3 Section 08 36 40 - Glazed Overhead Doors.
  - .4 Section 08 44 13 - Glazed Aluminum Framing Systems.
- .3 Furnish manufacturers' instructions for proper installation of each hardware component.

**3.2 HARDWARE**

- .1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Conversion Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .2 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .3 Install key control cabinet.
- .4 Use only manufacturer's supplied fasteners. Failure to comply may void manufacturer's warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .5 Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - .1 Standard Steel Doors and Frames: DHI's "TDH-009-20 Recommended Locations for Architectural Hardware for Standard Steel Frame."
  - .2 Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  - .3 Where indicated to comply with accessibility requirements, comply with ICC A117.1 "Accessible and Usable Buildings and Facilities."
  - .4 Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- .6 Remove construction cores when directed by Owner, install permanent cores and check operation of locks.

**3.3 INSTALLATION: AUTOMATIC SWING DOOR OPERATORS**

- .1 Install components as indicated on Shop Drawings and as scheduled to manufacturer's recommendations.
- .2 Install door holders to limit doors to opening swing specified.
- .3 Install operators on interior side of exterior entrances.
- .4 Install rubber dampening devices to sound isolate operators from door frames.
- .5 Isolate aluminum surfaces from contact with cementitious materials, using thick coating of bituminous paint. Let paint dry before installation of aluminum component.

- .6 Conceal wiring between activating devices, electric locking system, and operators.
- .7 Coordinate and confirm mechanical systems are balanced to ensure proper closing of doors.

### **3.4 ADJUSTING**

- .1 Adjust door hardware, operators, closures, and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to provide tight fit at contact points with frames.

### **3.5 DEMONSTRATION**

- .1 Keying System Setup and Cabinet:
  - .1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.
  - .2 Place file keys and duplicate keys in key cabinet on their respective hooks.
  - .3 Lock key cabinet and turn over key to Owner.
- .2 Maintenance Staff Briefing:
  - .1 Brief maintenance staff regarding:
    - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
    - .2 Description, use, handling, and storage of keys.
    - .3 Use, application and storage of wrenches for door closers, locksets, and fire exit hardware.
- .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

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**3.8 SCHEDULE**

- .1 Coordinate with electrical trades as required.
- .2 Refer to reviewed Door Hardware Schedule, and coordinate submitted Door / Hardware Index and Door Hardware Groups with the Drawings to determine the Hardware Group and associated products to install at each door. Consult with Owner and Consultant as required to determine exact needs and requirements for each door location.
- .3 Verify requirements with Owner and Consultant prior to ordering hardware and installing products; confirm that door function and electrical and security requirements have been properly understood and implemented for each door location.
- .4 Coordinate with other trades as required.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 14 - Metal Doors and Frames.
- .2 Section 08 14 16 - Wood Doors.
- .3 Section 08 44 13 - Glazed Aluminum Framing Systems.
- .4 Section 13 34 19 - Pre-engineered Metal Building RFQ.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI Z97.1-2015 (R2020), Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- .2 ASTM International (ASTM).
  - .1 ASTM C542-05(2017) Standard Specification for Lock-Strip Gaskets.
  - .2 ASTM C716-06(2020), Standard Specification for Installing Lock-Strip Gaskets and Infill Glazing Materials.
  - .3 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
  - .4 ASTM C964-20, Standard Guide for Lock-Strip Gasket Glazing.
  - .5 ASTM C1048-18, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
  - .6 ASTM C1172-19, Standard Specification for Laminated Architectural Flat Glass.
  - .7 ASTM C1349-17, Standard Specification for Architectural Flat Glass Clad Polycarbonate.
  - .8 ASTM D2240-15e1(2021), Standard Test Method for Rubber Property—Durometer Hardness.
  - .9 ASTM E119-22, Standard Test Methods for Fire Tests of Building Construction and Materials.
  - .10 ASTM E330/E330M-14(2021), Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
- .3 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-12.1-2017, Safety Glazing.
  - .2 CAN/CGSB-12.3-M91 (R2017), Flat, Clear Float Glass.
  - .3 CAN/CGSB-12.4-M91 (R2017), Heat Absorbing Glass.
  - .4 CAN/CGSB-12.8-2017, Insulating Glass Units.
- .4 CSA Group (CSA).
  - .1 CSA AAMA/WDMA/CSA 101/I.S.2/A440:22, North American Fenestration Standard/Specification for windows, doors, and skylights, Includes Errata (2023).
  - .2 CSA A440.2:22/A440.3:22, Fenestration energy performance/User Guide to CSA A440.2:19, Fenestration energy performance.
  - .3 CSA A440.4:19, Window, door, and skylight installation.
  - .4 CSA A500-16 (R2021), Building guards.
  - .5 CSA Certification Program for Windows and Doors.

- .5 Glass Association of North American (GANA)
  - .1 GANA Glazing Manual (50th Anniversary Edition).
  - .2 GANA Laminated Glazing Reference Manual (2019 edition).
- .6 National Fire Protection Association (NFPA):
  - .1 NFPA (FIRE) 80, Standard for Fire Doors and Other Opening Protectives, 2022 Edition.
  - .2 NFPA (FIRE) 252, Fire Tests of Door Assemblies, 2022 Edition.
  - .3 NFPA (FIRE) 257, Fire Test for Window and Glass Block Assemblies, 2022 Edition.
- .7 Underwriters' Laboratories (UL):
  - .1 UL-2761, Sustainability for Sealants and Caulking Compounds, 1<sup>st</sup> Edition.
- .8 ULC Standards (ULC)
  - .1 ULC 101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials (CAN/ULC S101-14).
  - .2 ULC 104-15, Standard Method for Fire Tests of Door Assemblies (CAN/ULC S104-15).
  - .3 ULC 106-15, Standard Method for Fire Tests of Window and Glass Block Assemblies (CAN/ULC S106-15).

### **1.3 PROJECT DRAWINGS AND DETAILS**

- .1 Project drawings and details are diagrammatic and are intended to show design concept, configuration, components and arrangements; they are not intended to identify nor solve completely the problems of structural movements, assembly framing, fixings and anchorages, size and shape of glazing pockets, and problems at the glass line associated with glass installation.
- .2 Profiles, elevations and sizes shown on the drawings are approximate and show intent, but do not preclude the use of manufacturer's standard sections and glazing methods provided performance requirements are met.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, standard details, and data sheets.
- .3 Shop Drawings:
  - .1 Submit shop drawings for window glazing and include the following:
    - .1 Submit glass thermal and wind load stress analysis documenting adequate glass thickness and/or heat treatment to meet stresses generated. Thermal stress analysis to consider effects of external shading, conduction at glass edge, heat build-up and contribution of tinted glass and low-e coatings.
    - .2 Indicate IGU system U-values and SHGC values, inclusive of IGUs and framing considered together as a system, and confirm for each system that it meets or exceeds the Contract design and energy savings requirements as noted on the Drawings, and the requirements of the Ontario Building Code.

- .3 Indicate the details and construction of IGUs, including composition of each pane, primary and secondary seals, identification of low-e coating(s) included, type and concentration of gas fill, and location(s) of low-e coating(s) on 2<sup>nd</sup> and/or 3<sup>rd</sup> glass surface(s).
- .2 Shop drawings shall be signed and sealed by a professional engineer qualified in the province of the Work, and who was responsible for their preparation.
- .4 Samples for selection and verification:
  - .1 Submit 300 mm x 300 mm size of each glazing type and colour. Consultant reserves the right to change colour of glass after review of submitted samples.
  - .2 Provide 300 mm x 300 mm sample of dual-sealed insulating glass unit with low-e coating.
- .5 Certifications:
  - .1 Submit proof of IGMAC certification for insulating glass units, including component codes.
  - .2 Submit manufacturers' certification of compatibility of glass, glazing and sealant materials.
  - .3 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements
- .6 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.
- .7 Warranties:
  - .1 Submit specified warranties.
- .8 Closeout Submittals:
  - .1 Submit adequate written instructions for protection of completed work, for re-glazing, and for proper methods and materials to be used in cleaning for incorporation into manual specified in Operation and Maintenance Manual.

## **1.5 QUALITY ASSURANCE**

- .1 Manufacturer's technical recommendations:
  - .1 Perform glazing work in accordance with written recommendations from the glass manufacturer or glass fabricator.
  - .2 Certify glass compatibility with glazing materials (i.e. insulating glass sealants, structural sealants and silicones, gaskets, setting blocks, etc.)
  - .3 Designs to be analyzed for thermal stress.
  - .4 Provide shop inspection for glass.
- .2 Tempered glass shall be heat soaked in accordance with EN 14179-1 and EN 14179-2 for the following applications: tempered glass spandrel panels, railings, balustrades, exposed overhead locations, exterior exposures one or more stories above pedestrian areas, structural glazing with spider or other fittings, frameless glass doors, tempered glass panes 10 mm thick or thicker, and fabricated glass with cut outs, notches, holes or countersinks (tempering takes place after fabrication).
  - .1 Provide the manufacturer's factory label on each unit confirming tempered glass has been heat soaked.

- .3 Insulating glass units (IGU) shall be fabricated by manufacturer who has certified these units in accordance with the IGMAC Certification Program. Insulation glass units shall bear valid IGMAC Certification number. Insulating glass units shall be manufactured solely by an IGMA member in good standing.
- .4 Single-source fabrication responsibility: All fabricated glass shall be processed and supplied by a single fabricator.
- .5 Installer Qualifications: Installer shall have a minimum of five years' experience in installing products comparable to those specified in this section.
- .6 Test Reports: If requested by Consultant, submit certified test reports showing compliance with specified performance characteristics and physical properties.
  - .1 Provide testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.
  - .2 Provide shop inspection and testing for glass.
- .7 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .8 Provide continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
  - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
  - .2 Size glass to withstand wind loads, deck loads and positive and negative live loads acting normal to plane of glass to a design pressure of 75 kPa as measured in accordance with ANSI/ASTM E330.
  - .3 Limit glass deflection to 1/200 with full recovery glazing materials.

## **1.6 SITE CONDITIONS**

- .1 Environmental Requirements:
  - .1 Install glazing when ambient temperature is 10 °C minimum. Maintain ventilated environment for 24 hours after application.
  - .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

## **1.7 WARRANTIES**

- .1 Provide manufacturers guarantee for the following types of glass listed, against defects in materials and workmanship for the period indicated, commencing from the date of Substantial Performance of Work.
  - .1 Flat Glass - General: Warrant that all flat glass products meet specified CGSB, ANSI, and ASTM standards, have been delivered to site with manufacturer's labels intact, and have been installed as required to meet or exceed applicable Building Code criteria.
  - .2 Sealed Glass Units: Replace units that exhibit failure of hermetic seal under normal use evidenced by the obstruction of vision by dust, moisture, or film on interior surface of glass: 10 Years.
  - .3 Coated Glass: Replace units that display peeling, cracking, and other deterioration in metallic coating under normal use: 10 Years.

- .4 Warrant that glazing work is water and weather tight and free from distortion; that glazing materials will not be displaced, and will be free from permanent deformation under load; and that glass and insulating glass units will not be broken, cracked or scratched by causes resulting from defects in material, workmanship or design of glazing installation.
- .5 Warrant that glazing materials will not deteriorate from exposure to the atmosphere and weather: 10 years.
- .6 Cracked or scratched glass, shrinking, cracking, staining, hardening, sagging of glazing materials; loosening or rattling of glass; leaking of glazed joints will be considered defective work and Contractor shall replace with new Work at no cost to Contract.
- .7 Glazing film: provide manufacturer's 15-year limited warranty.

## **Part 2 Products**

### **2.1 DESIGN CRITERIA**

- .1 Design Requirements:
  - .1 Refer to the Drawings for energy savings requirements and ensure that the Work of this Section is in compliance.
  - .2 Meet or exceed the requirements of the Ontario Building Code.
  - .3 Guards: to CSA A500.
  - .4 Size glass to withstand dead loads and positive and negative live loads as measured in accordance with ANSI/ASTM E330.
  - .5 Glass that is used or functions as a guard as defined by the applicable Building Code shall meet or exceed the standards and recommendations of CSA A500.
  - .6 Safety Glass: shall meet or exceed criteria and standards established by CGSB 12.1 and ANSI Z97.1 Class A.
  - .7 Glazing installation shall meet or exceed requirements of applicable Building Code, with deflection less than 1/175.
  - .8 Glazing for Fire-Rated Door and Window Assemblies: Glass tested per NFPA 252 and NFPA 257, as applicable, for assemblies complying with NFPA 80 and listed and labelled per requirements of authorities having jurisdiction.
- .2 Required Edge Treatments:
  - .1 Concealed edges: flat belt ground and seamed.
  - .2 Structural Silicone Glazed (SSG) edges: flat belt ground and seamed.
  - .3 Butt joined edges with silicone seal: flat ground with arris.
  - .4 Exposed edges: flat polish with arris.

### **2.2 MATERIALS**

- .1 Tempered Safety Glass: tempered glass to CAN/CGSB-12.1, glazing quality, clear/transparent, thickness as required to meet ANSI Z97.1 Class A but not less than 6 mm thick. At locations where full-height glass panes are used (e.g., panes  $\geq$  2200 mm in height), minimum thickness shall be 8 mm.
  - .1 Design: to meet or exceed the requirements of applicable Building Code, and CSA A500.
  - .2 Type: 1-tempered; Class: B float.



- .3 Category: ANSI Z97.1 Class A.
- .2 Tinted Tempered Safety Glass – Light Grey Colour: to CAN/CGSB-12.4 and CAN/CGSB-12.1. Submit several samples of light grey glass to Consultant for initial selection of colour before ordering materials.
- .3 Fire Rated Glass: transparent, comprised of multiple layers of tempered glass ceramic, laminated with transparent intumescent materials, providing distortion free viewing through pane and as follows:
  - .1 Thickness: as required by manufacturer to meet structural requirements for performance ratings specified.
  - .2 Impact Safety Rating: Category II, 2000 J/m in accordance with ANSI Z97.1.
  - .3 Temperature Rise Rating: Not required.
  - .4 Fire Rating: as noted on Drawings.
  - .5 Daylight Transmission:  $\geq 86\%$ .
  - .6 Labelled: Permanent logo listing name of product, manufacturer, testing laboratory, fire rating period and safety requirements.
  - .7 Glass, doors and door hardware, glazed screens and windows in fire resistance rated assemblies shall be supplied care of a single manufacturer, clearly labelled, with the assembly and systems meeting fire resistance rating requirements indicated on Drawings.
  - .8 Standard of Acceptance:
    - .1 InterEdge Technologies.
    - .2 SAFTI Fire and Safety Rated Glass.
    - .3 Saint-Gobain Glass Solutions.
    - .4 Technical Glass Products.
    - .5 Pilkington Pyrostop.

## 2.3 SPANDREL GLASS

- .1 Spandrel glass: to CAN/CGSB 12.9, glazing quality, 6 mm thick.
  - .1 Type: 1 Tempered.
  - .2 Class: A-Float.
  - .3 Style: 3 Organic - applied silicone elastomeric.
  - .4 Form: M-Monolithic.
  - .5 Colour: Black, to be selected by Consultant from manufacturer's full range.
  - .6 Acceptable Materials:
    - .1 Opaci-Coat 3000.
    - .2 Prel-Coat.
    - .3 Span-Kote.

## 2.4 SEALED INSULATING GLASS UNITS

- .1 Insulating Glass Units (IGU): shall be dual-pane insulating glass units, and shall meet or exceed the requirements of CAN/CGSB-12.8 and the energy performance requirements noted on the Drawings, and must be certified by Insulated Glass Manufacturers Alliance (IGMA) – no exceptions. Use two-stage seal method of manufacture, as follows:
  - .1 Use two-stage seal method of manufacture, as follows:
    - .1 Spacer: Prelco R-max™ Warm-Edge Spacer, Quanex Super Spacer® TriSeal™, or equivalent.

- .2 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two panes of glass at the edge up to the spacer.
- .2 Submit a signed, sealed engineered Shop Drawings, indicating that the provided insulating glass unit (IGU) meets energy saving requirements as noted on the Drawings and the OBC. The IGUs must comply with the Drawings, and have the following minimum components:
  - .1 Two-stage seal system.
  - .2 Outboard pane: Light-Grey Colour Tempered Safety Glass, 6 mm (1/4") thick. Colour as per approved sample.
  - .3 Inter-cavity space: 13 mm (1/2") space with low-conductivity spacers.
  - .4 Inert gas fill: ≥90% argon or krypton filled.
  - .5 Inboard pane: Clear Tempered Safety Glass, 6 mm (1/4") thick.
  - .6 Low-e Coating(s): on 2<sup>nd</sup> and/or 3<sup>rd</sup> surface(s) as per reviewed Shop Drawings meeting energy saving values as noted on Drawings.

## **2.5 SILVERED MIRROR GLASS**

- .1 Silvered mirror glass: to ASTM C1503, 6 mm thick, silvering quality.
  - .1 Type: 3C- Film reinforced; safety film backing to CPSC 16 CFR; equivalent to No. 2MT Category Two Mirror Safety Backing by C. R. Laurence or 3M.
  - .2 Tint: Clear.
  - .3 Edges: ground and polished with arris.

## **2.6 ACCESSORIES**

- .1 Glazing Film (Visibility strips): to item VISIBILITY STRIPS of this section 08 80 50.
- .2 Perimeter Joint Sealant: in accordance with Section 07 92 00 – Joint Sealants, compatible with secondary edge sealant.
- .3 Two-Part Structural Glazing Silicone Adhesive: ETA-approved and evaluated to a tensile strength of not less than 1.6 N/mm<sup>2</sup>; approved and recommended by glass manufacturer.
- .4 Setting blocks: Neoprene, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .5 Spacer shims: Neoprene, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.
- .6 Glazing tape:
  - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; black colour.
  - .2 Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume 2%, designed for compression of 25%, to effect an air and vapour seal.
- .7 Glazing compound for fire rated glazing materials:
  - .1 Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2%, designed for compression of 25% to affect an air and vapour seal.
  - .2 Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50% in both

extension and compression (total 100%); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.

- .1 Standard of Acceptance:
  - .1 Dow Corning Corp., Dow Corning 795
  - .2 General Electric Co., Silglaze-II 2800
  - .3 Tremco Inc., Spectrum 2
- .3 Setting Blocks: Hardwood, glass width by 100 mm x 5 mm thick.
- .4 Spacers: 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.
- .5 Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.
- .8 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, black colour.
- .9 Glazing clips: manufacturer's standard type.
- .10 Lock-strip gaskets: to ASTM C542.
- .11 Mirror attachment accessories:
  - .1 Stainless steel edge clips, with fastening concealed behind mirror.
  - .2 Mirror adhesive, chemically compatible with mirror coating and wall substrate.
- .12 Other Glazing Accessories: to CAN/CSA A440.
- .13 Screws, bolts and fasteners: ASTM F738M; Type 304 stainless steel.
- .14 Glass presence markers: easily removable, non-residue depositing.

## **2.7 VISIBILITY STRIPS**

- .1 Patterning on glass partitions/screens: where indicated on Drawings: shop-applied strips to provide frosted appearance at strips in pattern indicated.
  - .1 One horizontal row of translucent (frosted) strips, located as required to meet OBC requirements, and as per Drawings.
  - .2 Refer to Drawings for dimensions of strips, located as indicated.
  - .3 Applied to room side face of glass.
  - .4 Provide manufacturer's recommended pressure-sensitive glazing film adhesive as required for a complete installation.
  - .5 Manufacturer's Warranty: 15 years.
  - .6 Opacity: Translucent.
  - .7 Removability: Permanent.
  - .8 Removal Method: removable with a heat gun at 80°C – 100°C.
  - .9 Surface Finish: Matte.
  - .10 Surface Type: Flat.
  - .11 Thickness (film): 50 µm.
  - .12 Acceptable Materials:
    - .1 3M Company.
    - .2 Llummar

## 2.8 FABRICATION

- .1 Verify glazing dimensions on Site.
- .2 Clearly label each glass light with maker's name, weight, quality, type and certification number. Do not remove labels until after work has been reviewed by Consultant.
- .3 Accurately size glass to fit openings allowing the clearances shown on the following tables:

- .1 Minimum glass clearances:

Glass Pane Thickness	Edge Clearance	Face Clearance
6 mm	6 mm	3 mm
over 6 mm	6 mm or 3/4 times the glass thickness, whichever is greater	

\* = where any dimension of glass exceeds 760 mm increase minimum edge clearance by 1.5 mm.

- .4 Bite of glass edge on stop:
  - .1 Up to 1270 mm united size: 6 mm minimum.
  - .2 1270 mm to 2540 mm united size: 10 mm minimum.
  - .3 Over 2540 mm united size: 13 mm minimum.

## Part 3 Execution

### 3.1 COMPLIANCE

- .1 Install work in accordance with the quality assurance provisions specified in this Section and manufacturer's printed instructions, data sheets, and standard details.
- .2 Size glass to OBC requirements, and verify glass for openings are correctly sized and are within allowable tolerances. Install glass with full contact and adhesion at perimeter. Maintain edge clearance recommended by glass manufacturer.
- .3 Ensure weep drainage from all exterior glazing channels and framing.
- .4 Adhere to the guidelines of the Insulating Glass Manufacturers Alliance (IGMA).

### 3.2 EXAMINATION

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
- .3 Commencement of work means acceptance of existing conditions.

### 3.3 PREPARATION

- .1 Ensure all glazing rebates are smooth and true, free of projections nails, screws, with fastenings properly set to prevent contact with glass.
- .2 Ensure all stops, splines, glazing accessories provided by others are accurately cut to length and proper size and type for specific glazing.
- .3 Clean contact surfaces with solvent and wipe dry.
- .4 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

- .5 Prime surfaces scheduled to receive sealant.

### **3.4 GENERAL**

- .1 Remove and replace glazing stops in original locations, using original fasteners, securely set and undamaged.
- .2 Use setting blocks, spacers and, for wet glazing, shims, as required to properly support the glass, centred in place in the glazing space independent of the glazing materials and to uniformly distribute its load.
- .3 Use a minimum of two setting blocks, located at the quarter points. Locate spacers at jamb edges of glass, uniformly spaced at 600 mm o.c. maximum, and 300 mm maximum from top to bottom.
- .4 Assess ceramic frit bird-friendly and opaque glass for aesthetic uniformity and arrange to avoid abrupt variation in appearance.
- .5 Handle and install heat absorbing glass in accordance with manufacturer's directions.
- .6 Prevent nicks, abrasion and other damage likely to develop stress on edges.
- .7 Set glass properly centred with uniform bite and face and edge clearance, free from twist, warp or other distortion likely to develop stress.
- .8 Trim tape protruding more than 2 mm above stop.
- .9 Leave labels on glass until it has been set and inspected and accepted. Leave glass whole and without cracks, scratches or other defects and with settings in perfect condition at completion. Remove rejected, broken or damaged glass due to defective materials or improper setting and replace with acceptable materials. Units producing distorted vision shall be rejected and replaced at no cost to the Owner.
- .10 Remove, dispose of, and replace broken, cut and abraded glass.
- .11 Install glass presence markers in two cross stripes extending from diagonal corners. Maintain markers until final clean-up

### **3.5 EXTERIOR**

- .1 Arrange for installed glass to have labels facing the interior. Ensure that sufficient space is left within the glazing space to allow thermal movement of glass without imposing stress on the glass.
- .2 Install curtain wall, punch window and entrance glazing to Section 08 44 13 - Glazed Aluminum Framing Systems, and as follows:
  - .1 Perform work in accordance with GANA Glazing Manual.
  - .2 Cut glazing spline to length; install on glazing light. Seal corners by butting spline and sealing junctions with sealant.
  - .3 Place setting blocks at one third points, with edge block maximum 150 mm from corners.
  - .4 Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
  - .5 Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
  - .6 Trim protruding tape edge.
- .3 Glaze wood doors in accordance with the requirements of this Section and as per Section 08 14 16 - Wood Doors.

- .4 Overhead door glazing by overhead door manufacturer and installer, as per the requirements of Section 08 36 40 - Glazed Overhead Doors.
- .5 Install pressed steel frame and hollow steel door glazing as follows:
  - .1 Perform work in accordance GANA Glazing Manual.
  - .2 Cut glazing tape to length and set against permanent stops, 6 mm below sight line. Seal corners by butting tape and dabbing with sealant.
  - .3 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.
  - .4 Place setting blocks at one third points, with edge block maximum 150 mm from corners.
  - .5 Rest glazing on setting blocks and push against tape and heel head of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.
  - .6 Install removable stops with spacer strips inserted between glazing and applied stops, 6 mm below sight line.
  - .7 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 9 mm below sight line.
  - .8 Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### 3.6 INTERIOR

- .1 Glazing materials and installation to meet OBC requirements for fire rated separations where required; refer to Drawings for locations of fire-rated separations.
- .2 Arrange for installed glass to have labels facing the interior. Ensure that sufficient space is left within the glazing space to allow thermal movement of glass without imposing stress on the glass.
- .3 Provide insulating glass units in sound attenuated partitions.
- .4 Unless otherwise specified or indicated, interior glazing shall be dry glazing.
- .5 Install extruded resilient channel gasket around entire perimeter of glass. Make tight butt joint at corners of lights. Place setting blocks at sill and spacers at both jambs as required to centre the unit in the frame. Place the unit into the frames and apply the stops against the gaskets. Tighten the screws or clips to obtain positive uniform pressure avoiding excessive pressure.
- .6 Ensure rattle free cushioning.
- .7 Install spacer shims at 600 mm o.c. to centre balustrade glazing in rebate space. Install shims 6 mm below sight line. Apply cap bead of glazing sealant to uniform line, flush with rebate sightline and tool to smooth appearance, both sides.
- .8 Install two-sided frameless structural butt joint glass assemblies where indicated using tempered safety glass with slightly wet grinded kerf and polished butt-joint edges for aesthetics. Ensure precise levelling of sill member achieved and provision made at head to accommodate deflection of structure. For glazing at head and sill use wet, dry, or wet/dry glazing systems. Position glazing so vertical edges spaced slightly apart and seal with clear, colourless, or coloured silicone sealant. At framing or rebate locations, provide silicone sealant in clear, colourless, or colour selected by Consultant. Ensure sealant flush with and does not protrude above glazing stop or rebate.
- .9 Install wet glazing materials to obtain complete contact and adhesion over the full bite area of the unit and to be free from gaps, air bubbles and embedded foreign matter. Use

primers where recommended by the glazing material manufacturer. Use sufficient bedding compound so that when glass is pressed into place, excess compound is forced well out around entire margin. Use shims to ensure maintenance of uniform face clearance. Where required on both sides of a unit, make shims coincident.

- .10 Install glazing tape to ensure complete contact and adhesion over the full bite area of the unit. Make joints only at corners of the unit. Use pre-shimmed glazing tape at glass installed with pressure plates. Fit tape accurately with tight joints, free from tension, gaps and cracks. After installation of the glass, the glazing tape shall not extend more than 3 mm above the line of the fixed stop. Remove and reglaze units where the glazing tape exceeds this tolerance.
- .11 Gun in a heel bead of glazing compound ensuring a continuous seal between glazed element and frame.
- .12 Finish gunned bead surfaces uniformly smooth and straight, to slope away from glass.

### **3.7 INSTALLATION - FIRE RATED GLASS**

- .1 Comply with GANA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- .2 Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- .3 Place hardwood setting blocks located at quarter points of glass with edge block no more than 150 mm from corners.
- .4 Glaze vertically into labelled fire rated steel frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described above.
- .6 Do not remove protective edge tape.
- .7 Install removable stop and secure without displacement of tape.
- .8 Do not pressure glaze.
- .9 Knife trim protruding tape.
- .10 Provide minimum 5 mm edge clearance.
- .11 Install vision panels in fire rated doors to requirements of NFPA 80.
- .12 Install so that appropriate fire rating labels and markings remain permanently visible.

### **3.8 INSTALLATION: MIRRORS**

- .1 Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions.
- .2 Set mirrors with clips using hidden fastening system. Anchor rigidly to wall construction.
- .3 Secure mirrors with a minimum of four clips per piece. Provide pads to prevent direct metal-to-glass contact of clips or screws.
- .4 Align mirrors (in multiple application) to a parallel and true plane surface to produce a true reflection across all sections.
- .5 Install plumb and level.

### 3.9 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services: Upon Consultant's written request provide periodic site visits by manufacturer's field service representative.

### 3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### 3.11 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### 3.12 SCHEDULE

- .1 The following table establishes minimum glass thicknesses for interior glass sidelights, screens, windows and doors; all installations must meet or exceed the OBC. Where glass thickness is indicated on Drawings, the indicated thickness is the minimum thickness required.

Table A		
Area	Framed Panel	Free Standing Glass or Glass Located within 1067 mm of floor.
$\leq 3.7 \text{ m}^2$	6 mm annealed float glass	6 mm tempered
$3.7 \text{ m}^2 \text{ to } 5.5 \text{ m}^2$	6 mm annealed float glass	10 mm tempered
$5.5 \text{ m}^2 \text{ to } 11.1 \text{ m}^2$	10 mm annealed float glass	13 mm tempered
$> 11.1 \text{ m}^2$	Design glass on an individual basis.	

- .2 Schedule: install glass as specified herein and as indicated on Drawings.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 - Structural Metal Stud Framing.
- .2 Section 05 50 00 - Metal Fabrications.
- .3 Section 07 26 13 - Polyethylene Vapour Control System.
- .4 Section 07 84 00 - Firestopping and Smoke Seals.
- .5 Section 07 92 00 - Joint Sealants.
- .6 Section 09 22 00 - Non-Structural Metal Framing.

**1.2 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 AA DAF-45, Designation System for Aluminum Finishes.
- .2 ASTM International (ASTM)
  - .1 ASTM C475/C475M-17(2022), Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .2 ASTM C514-04(2020), Specification for Nails for the Application of Gypsum Board.
  - .3 ASTM C557-03(2017), Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
  - .4 ASTM C840-24, Specification for Application and Finishing of Gypsum Board.
  - .5 ASTM C954-22, Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
  - .6 ASTM C1002-22, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .7 ASTM C1047-19, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .8 ASTM C1177/C1177M-24, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .9 ASTM C1178/C1178M-24, Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
  - .10 ASTM C1278/C1278M-24, Standard Specification for Fiber-Reinforced Gypsum Panel.
  - .11 ASTM C1396/C1396M-24, Standard Specification for Gypsum Board.
  - .12 ASTM C1629
  - .13 ASTM C1658/C1658M-19(2024), Standard Specification for Glass Mat Gypsum Panels.
  - .14 ASTM E695-22, Standard Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading.
- .3 Gypsum Association (GA)
  - .1 GA-214-2021, Recommended Levels of Gypsum Board Finish.
  - .2 GA-216-2024, Application and Finishing of Gypsum Panel Products.

- .4 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC S102:2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and data sheet for each product specified.
- .3 Shop Drawings:
  - .1 Submit Shop Drawings showing elevations, sections, and details of construction.
  - .2 Refer to and comply with the requirements of Section 01 11 00 Summary of Work, item 1.7 POST-DISASTER BUILDING.
  - .3 Delegated Design Requirements:
    - .1 For suspended ceiling applications, fire resistive rated walls, and for walls exceeding 3050 mm in height, locations with two or more thicknesses of gypsum board, acoustical ceilings with 1 layer or more of gypsum board, and securement of ceiling mounted fixtures and components, submit shop drawings designed and sealed by a Professional Engineer (P.Eng.) licenced to practice in the Province of Ontario, showing elevations, plans, sections, and details, including engineering calculations.
    - .2 Refer to Drawings for additional engineering requirements
    - .3 Submit confirmation of stud thicknesses and spacings to suit spans and conditions as required to satisfy OBC and L/240 maximum deflection.

### **1.4 QUALITY ASSURANCE**

- .1 Delegated Design: Contractor shall engage the services of a Professional Engineer (P.Eng.) licenced to practice in Ontario to design and seal shop drawings.
- .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Fire-Test-Response Characteristics: For fire resistance-rated assemblies that incorporate non-loadbearing interior steel framing, provide materials and construction identical to those tested in assembly indicated according to CAN/ULC S101.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.
- .2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.
- .3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

### **1.6 SITE ENVIRONMENTAL REQUIREMENTS**

- .1 Maintain temperature minimum 10°C, maximum 21°C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost-free surfaces.
- .3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Manufacturers:
  - .1 Cabot Gypsum Company.
  - .2 CertainTeed Gypsum Canada Inc.
  - .3 CGC Inc.
  - .4 Georgia-Pacific Canada, Inc.

### **2.2 GYPSUM MATERIALS**

- .1 Provide gypsum board materials and accessories as required to comply with ULC DESIGN NO. L533, which is required at F-3 mezzanine floor assembly.
  - .1 Type C Fire Rated Board, as follows:
    - .1 Acceptable Materials:
      - .1 National Gypsum Co.; Type: FSK-C, or FSW-C.
      - .2 United States Gypsum Co., Type C
      - .3 CGC Inc., Type: Sheetrock Firecode C, Sheetrock Firecode C WR, Sheetrock Mold tough firecode C.
  - .2 Abuse resistant board: high-density, paperless gypsum panels with cellulose fibre reinforced facers and reinforcing fiber mesh to ASTM C1629/C1629M and ASTM C1278/C1278M and as follows:
    - .1 Type: regular and/or fire resistant as required to suit assembly requirements as noted on Drawings.
    - .2 Thickness: 16 mm.
    - .3 Surface Abrasion: Level 1 classification in accordance with ASTM D4977.
    - .4 Indentation Resistance: Level 1 classification in accordance with ASTM C1629.
    - .5 Soft Body Impact Resistance: Level 3 classification in accordance with ASTM E695.
    - .6 Hard Body Impact Resistance: Level 3 classification in accordance with ASTM C1629/C1629M.
    - .7 Standard of Acceptance:
      - .1 Sheetrock Brand Panel Mold Tough VHI Firecode X, CGC Inc., or approved equivalent.
- .3 Standard board: to ASTM C1396/C1396M and as follows:
  - .1 Type: regular and/or fire resistant as required to suit assembly requirements as noted on Drawings.
  - .2 Size: 1200 mm x maximum practical length.
  - .3 Thickness: as indicated on Drawings.

- .4 Ends: square cut.
- .5 Edges: tapered.
- .6 Standard of Acceptance:
  - .1 ProRoc Wallboard (Type X), CertainTeed.
  - .2 Sheetrock (Firecode), CGC Inc.
  - .3 Toughrock Gypsum Wallboard (Fireguard), Georgia-Pacific Canada, Inc.
  - .4 Cabot Regular Board and Cabot Type X Light.
- .4 Non-cementitious backer board: to ASTM C1178/C1178M and as follows:
  - .1 Type: as required.
  - .2 Size: 1220 mm x maximum practical length.
  - .3 Thickness: as indicated on Drawings
  - .4 Acceptable Materials:
    - .1 Glasroc Tile Backer (Type X), CertainTeed.
    - .2 Fiberock Aqua-Tough Interior Panel Abuse Resistant (Type FRX), CGC Inc.
    - .3 DensShield (Fireguard) Tile Backer, Georgia Pacific.
- .5 Cementitious board: to ASTM C1325 and as follows:
  - .1 Size: 1220 mm x maximum practical length.
  - .2 Thickness: as indicated on Drawings.
  - .3 Acceptable Materials:
    - .1 Durock® Brand Cement Board with EdgeGuard™, CGC Inc.
    - .2 WonderBoard® Backerboard, Custom Building Products Ltd.
- .6 Mould-resistant glass mat faced paperless board, to ASTM C1658 and as follows:
  - .1 Type: regular and/or fire resistant as required to suit assembly requirements as noted on Drawings.
  - .2 Size: 1220 mm x maximum practical length.
  - .3 Thickness: as indicated on Drawings.
  - .4 Standard of Acceptance:
    - .1 Protec M + M Gypsum Panels, Cabot.
    - .2 DensArmor Plus® Interior Panels, Georgia-Pacific Canada, Inc.
    - .3 Gold Bond® eXP® Interior Extreme® Gypsum Panel, Gold Bond Building Products, LLC.
    - .4 GlasRoc® Interior Drywall, CertainTeed.

## **2.3 FRAMING MATERIALS**

- .1 Metal stud framing, suspension systems and framing accessories and ancillary products: as specified in Section 09 22 00.

## **2.4 ACOUSTICAL INSULATION MATERIALS – INTERIOR WALLS AND CEILINGS**

- .1 Fibrous acoustical insulation: refer to Section 07 21 16 - Fibrous Insulation.
- .2 Acoustical Putty Pads:

- .1 Acoustical putty pads provide acoustical sealant for wall penetrations in the form of a poly-lined pad for application to electrical boxes or other penetrations. Pads sized to fit standard single or double gang boxes with no cutting or piercing required.
- .2 Cut and apply acoustical putty pad strips through and around penetrations for wire, cable, etc. Cut strips of the pad and pack around wall openings as required to maintain the acoustical performance of the assembly.
- .3 Firestop Acoustical Putty Pads, to be used at fire rated assemblies:
  - .1 Standard of Acceptance:
    - .1 Firestop Putty Pad, by Acoustical® Solutions, or equivalent.
- .4 Acoustical Putty Pads:
  - .1 Standard of Acceptance:
    - .1 Acoustical Putty Pad, by AcoustiGuard, or equivalent.

## 2.5 TRIM AND PROFILES

- .1 Standard of Acceptance Manufacturers: Bailey Metal Products Limited, Fry Reglet, Trim-Tex, and/or CertainTeed, products as follows where indicated and/or in accordance with the recommended practices of ASTM C840 and GA 216. The applicator shall select trim and profiles that best suit their application practices, and that meet ASTM C840 and GA 216:
  - .1 Ceiling Trim (Gypsum Board to Gypsum Board): Fry Reglet DRMCT-625-75.
  - .2 'J' Moulding (Edge Protection): Fry Reglet JDM-625.
  - .3 "F" Moulding (Ceilings – Gypsum Board to Other Materials): Fry Reglet DRMF-625-75.
  - .4 Window Returns, Door Enclosures, Drop Ceilings, Protective Edging: CertainTeed NO-COAT L-TRIM or Trim-Tex Tear Away L-Bead
  - .5 Column Head Reveal: Fry Reglet WRM-75-75-625.
  - .6 Other trim and mouldings as required in accordance with the recommended practices of ASTM C840 and GA 216.

## 2.6 ACCESSORIES

- .1 Isolation Coating: bituminous paint or aerosol.
- .2 Polyethylene vapour control system: to Section 07 26 13 - Polyethylene Vapour Control System.
- .3 Screws: to ASTM C1002; for gypsum board to steel stud: bugle head, Philips drive, fine thread, self-tapping, Type S or S-12 point to suit stud gauge, with corrosion resistant finish. 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.
- .4 Screws; for soffit board, high-impact abuse-resistant board and cement board: Wafer head, Type S-12 point or 'Hi-Lo', self-tapping, with corrosion resistant polymer finish.
- .5 Tie wire: 1.6 mm (0.063") diameter galvanized soft annealed steel wire.
- .6 Stud adhesive: to CAN/CGSB-71.25.
- .7 Laminating compound: Green Glue Soundproofing compound, by Soundproofing Company Inc., or approved equivalent soundproofing adhesive.

- .8 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, ABS or PVC, perforated flanges, one-piece length per location.
  - .1 Corner Beads: mud-applied No-Coat® drywall corners, by CertainTeed. Provide all types as required for a complete installation.
- .9 Strippable Edge Trim: Extruded PVC with pre-masked L-shaped tape on trim with tear away protective serrated strip for removal after compound and paint is applied, for use at areas where gypsum abuts aluminum frames and where gypsum butts concrete or concrete block.
- .10 Cornice cap: 12.7 mm deep x partition width, of 1.6 mm base thickness galvanized sheet steel, prime painted. Include splice plates for joints.
- .11 Trim-Tex 093V 10' Expansion/Control joint.
- .12 Acoustic clips and channels:
  - .1 Resilient IB-1 Sound Isolation Clips, by Soundproofing Company Inc., or approved equivalent.
    - .1 Use with resilient channel Only.
  - .2 Resilient channels: To ASTM C645, 0.58 mm (22 mil) thick steel, G40, with integral pre-punched attachment flange, screw attached.
    - .1 Furring channel is not acceptable in place of resilient channel.
- .13 Drywall Furring Channels: D-1001 Drywall Furring Channel, minimum 0.033-inch material thickness, by Bailey Metal Products Ltd., or approved equivalent.
- .14 Acoustical sealant: non-hardening, non-skinning, permanently flexible, in accordance with the requirements of Section 07 92 00 - Joint Sealants.
- .15 Insulating Strip: rubberized, moisture-resistant, 3 mm thick closed cell neoprene or EPDM, full width of stud, with self-sticking permanent adhesive on one face, lengths as required.
- .16 Joint Treatment Materials: Provide joint compound and accessory materials in accordance with ASTM C475 and as follows:
  - .1 Joint Tape:
    - .1 Interior Gypsum Board: Paper.
    - .2 Tile Backing Panels: As recommended by panel manufacturer.
  - .2 Joint Compound for Interior Gypsum Board: Vinyl based, non-asbestos, low dusting type compatible with other compounds applied on previous or for successive coats, and as follows:
    - .1 Pre-filling: Setting type taping compound.
    - .2 Embedding and First Coat: Drying type compound.
    - .3 Fill Coat: Drying type compound.
    - .4 Finish Coat: Drying type, sandable topping compound.
    - .5 Skim Coat: Drying type, sandable topping compound.
    - .6 Standard of Acceptance:
      - .1 CertainTeed Dust Away
      - .2 CGC Dust Control
  - .3 Joint Compound for Tile Backing Panels:
    - .1 Gypsum based tile backing board: Use setting type taping and setting type, sandable topping compounds.

- .4 Joint Compound for Paperless Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - .1 Pre-filling: Setting type joint compound.
  - .2 Embedding and First Coat: Setting type joint compound.
  - .3 Fill Coat: Setting type, sandable topping compound.
  - .4 Skim Coat: Setting type joint compound, sandable topping compound.

## **2.7 SHOWERS**

- .1 Refer to Section 09 30 13 – Tiling, items 2.9 and 3.6, and coordinate application of Schluter® Shower System; cooperate with tile contractor as required to ensure continuity of waterproofing at shower enclosure.

## **2.8 FINISHES**

- .1 Finishes: to Section 09 06 00 (R0) - Finish Schedule.

## **Part 3 Execution**

### **3.1 COMPLIANCE AND GENERAL PROVISIONS**

- .1 Comply with manufacturer's printed installation instructions and illustrations, technical datasheets, and specifications.
- .2 Install and finish gypsum board in accordance with ASTM C840 and GA-216, except where specified otherwise.
- .3 Install hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840, except where specified otherwise.
- .4 Work shall meet or exceed Ontario Building Code requirements.
- .5 Demising and Acoustically Rated Walls:
  - .1 Studs shall be erected at 406 mm or 610 mm on centre.
  - .2 Resilient channels: spaced at 610 mm on centre, installed to acoustically separate gypsum board from studs. Locate resilient channels at corridor side where channels are installed at corridor/suite walls.
  - .3 Fill cavities between studs minimum 90% full with acoustic batt insulation.
  - .4 Seal perimeter joints with acoustical sealant.
  - .5 Electrical boxes and other wall inserts at each wall facing shall be offset so they are never back-to-back.
  - .6 Fully seal.

### **3.2 ISOLATION COATING**

- .1 Isolate runners/tracks from concrete by applying an isolation coating to underside of runner/track before placement and installation.
- .2 Apply isolation coating to contact surfaces in contact with concrete and cementitious materials, wood materials, and dissimilar metals.
- .3 Apply isolation coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).

- .4 Generally, 2 – 3 mil thickness is required per application. Apply enough product applied so that excess isolation coating “oozes out” during assembly to ensure proper seal.
- .5 Assemble and wipe away any excess product.

### 3.3 ERECTION

- .1 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .2 Install work level to tolerance of 1:1200.
- .3 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .4 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .5 Furr gypsum board faced vertical bulkheads within and at termination of ceilings.
- .6 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .7 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.
- .8 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .9 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .10 Erect furring channels and soundproofing clips and channels transversely across studs and joists spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screws.
- .11 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

### 3.4 APPLICATION

- .1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are reviewed and accepted.
- .2 Before application of gypsum board commences, ensure that internal services have been installed, tested, and approved; that conduits, pipes, cables, and outlets are plugged, capped, or covered; and that fastenings and supports installed by others are in place.
- .3 Unless otherwise specified, erect gypsum board vertically or horizontally, whichever results in the fewest end joints.
- .4 Apply single or double layer gypsum board as indicated to metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.
  - .1 Single-Layer Application:
    - .1 Apply gypsum board on ceilings prior to application of walls in accordance with ASTM C840.
    - .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.
  - .2 Double-Layer Application:
    - .1 Install gypsum board for base layer and exposed gypsum board for face layer.



- .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.
- .3 Apply base layers at right angles to supports unless otherwise indicated.
- .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.
- .5 Apply gypsum board to concrete and concrete block surfaces, where indicated, using laminating adhesive.
  - .1 Comply with gypsum board manufacturer's recommendations.
  - .2 Brace or fasten gypsum board until fastening adhesive has set.
  - .3 Mechanically fasten gypsum board at top and bottom of each sheet.
- .6 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of all gypsum board partitions to seal gypsum board/structure junction where partitions abut fixed building components. Seal all penetrations of partition and seal full perimeter of all partition cut-outs, such as around electrical boxes, ducts, and pipes.
  - .1 Refer to Section 07 92 00 – Joint Sealant for sealant to be used.
- .7 Install ceiling boards in direction that will minimize number of end butt joints. Stagger end joints at least 250 mm.
- .8 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
- .9 Install gypsum board with face side out.
- .10 Do not install damaged or damp boards.
- .11 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

### **3.5 ACOUSTIC WALL ASSEMBLY MATERIALS**

- .1 Locations: demising and acoustically rated walls.
- .2 General: Section 07 84 00 - Firestopping and Smoke Seals governs Work at fire rated assemblies.
- .3 Acoustical sealant and plaster:
  - .1 Apply two-bead caulking system around horizontal and vertical perimeters of partition walls. Apply continuous sealant beads at each side of horizontal runner tracks and vertical end studs, between gypsum board and adjacent construction.
  - .2 Apply bead of acoustic sealant to seal intersections with sound-isolating partitions that are extended to reduce sound flanking paths.
  - .3 Apply bead of acoustic sealant to seal joint between penetrations and gypsum board at concealed and non-rated installations only. Where exposed, use interior sealant in accordance with Section 07 92 00.
  - .4 Completely seal objects at wall and gypsum board penetrations with Acoustical Putty Pads or MLV sheeting.
  - .5 Apply acoustical sealant to clean, dry surfaces.
- .4 Sound attenuation insulation:
  - .1 Install sound attenuation insulation wherever insulation in partitions is indicated.

- .2 Install sound attenuation insulation in partitions so indicated by filling voids with batts of specified thickness.
- .3 Maintain air space between backs of sound attenuation insulation and back of opposite face layer, as applicable.
- .4 Pack sound attenuation insulation against ducts, conduits and services passing through acoustic wall assemblies.
- .5 Extend acoustic wall assemblies to underside of structure. Incorporate approved provision to prevent transmittance of structural deflection to partition assembly.
- .6 Install insulation by friction fit.
- .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.
- .8 Mechanically attach sound attenuation insulation in wall assemblies where cavity of wall assembly is greater than 150 mm.
- .9 Secure insulation in such a manner that it will not sag.
- .5 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 Provide acoustic insulation to fill steel deck flutes where acoustic wall assemblies abut steel floor or roof deck. At non-fire rated partitions, seal gap between gypsum board assemblies and underside of deck with sealant.
  - .4 At fire rated assemblies, use appropriate Code-compliant firestop methods and materials.

### 3.6 ACCESSORIES

- .1 At external corners install corner bead trim secured to framing at 230 mm on centre on both flanges using screw fasteners.
- .2 Secure casing trim at board edges where exposed to view, where board abuts against other materials that have no trim to conceal junction, and where indicated. Secure metal reveal trim where gypsum board abuts dissimilar materials at walls and ceilings. Fasten at maximum 230 mm on centre using screw fasteners.
- .3 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.

### 3.7 INSTALLATION

- .1 Install casing beads around perimeter of suspended ceilings.
- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .4 Construct control joints of preformed units or two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint.
- .5 Provide continuous polyethylene dust barrier behind and across control joints.

- .6 Locate control joints where indicated and at changes in substrate construction at approximate 10 m spacing on long corridor runs at approximate 15 m spacing on ceilings.
- .7 Install control joints straight and true.
- .8 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.
- .9 Locate joints on opposite sides of partitions on different studs, and at least 305 mm (12") from opening jambs.
- .10 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.
- .11 Form smooth joints at ends and at field cut edges of board panels.
- .12 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, center of joints. Space screws:
  - .1 At fire rated board as per fire-rated assembly.
  - .2 At typical board walls at 305 mm (12") on centre at edges and field unless otherwise required.
  - .3 At typical board ceilings at 305 (12") on centre at edges and field unless otherwise required.
- .13 Offset gypsum board seams from corners of openings.
- .14 Unless otherwise shown or specified, extend gypsum board on both side of partitions to underside of structural slab above. Fasten gypsum board to studs, not to top channel. Allow for minimum 20 mm deflection.
- .15 Extend gypsum board close to floor with gap between board and floor not exceeding 5 mm and with bottom edge of board straight and unbroken.
- .16 Provide metal mouldings and trim at corners and terminations. Fastened with drywall screws. Provide corner beads at external corners. Provide casing beads around openings and reveal trim where gypsum board abuts dissimilar materials and construction.
- .17 Adhesive bonded gypsum board; apply 13 mm x 13 mm ribbons of laminating adhesive to back side of board, parallel to long dimension; space adhesive ribbons at maximum 150 mm on centre. Temporarily brace boards until complete adhesive bond develops.
- .18 Where double layer gypsum board is required, screw fasten second layer through first, into framing, and offset joints.
- .19 Provide gypsum backing board for ceramic tile with coated side facing away from framing.
- .20 Install self-sticking resilient sponge isolation tape at edges of wall board in contact with aluminum curtainwall, aluminum windows and exterior door frames to provide a thermal break. Adhere isolation tape to casing bead and compress during installation.
- .21 Provide tile backer board behind ceramic wall tile.

### **3.8 TILE BACKER BOARD**

- .1 Install in accordance with manufacturer's published installation instructions and specifications.
- .2 Apply tile backer board with ends and edges over support framing or blocking. Fit ends and edges closely, but not forced together. Stagger end joints in successive courses.

- .3 Fasten tile backer board to framing with specified fasteners. Drive fasteners in field of cement board first, working toward ends and edges. Hold tile backer board in firm contact with framing while driving fasteners. Space fasteners along framing with perimeter fasteners at least 9.5 mm (0.374") and less than 15.9 mm (5/8") from ends and edges. Drive fasteners so bottom of heads are flush with surface of tile backer board to provide firm board contact with framing. Do not drive fastener heads below panel surface.
- .4 Maximum fastener spacing as follows: Walls: 200 mm (8").
- .5 Perimeters: minimum 9.5 mm (3/8") and maximum 15.9 mm (5/8") from ends and edges.

### **3.9 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 window, door, and curtainwall frames.
- .4 Erect beads plum or level, with minimum joints.
- .5 Provide metal reveal trim where gypsum board wall or ceiling abuts dissimilar materials and where indicated.
- .6 Provide aluminum reveal trim at perimeter of aluminum screens and where indicated.

### **3.10 CONTROL, EXPANSION, AND RELIEF JOINTS**

- .1 Control joints:
  - .1 Provide continuous polyethylene dust barrier behind and across control joints.
  - .2 Provide control joints set in gypsum board facing. Support control joints with studs or furring channels on both sides of joint.
  - .3 Provide control joints where indicated, where directed by Consultant, and as follows:
    - .1 Partitions: 7500 mm on centre, maximum
    - .2 Ceilings: 10 m on centre, maximum.
  - .4 In addition, provide control joints in locations, in consultation with Consultant, where:
    - .1 Partition or furring abuts a structural element (except floor) or dissimilar wall or ceiling;
    - .2 Ceiling abuts a structural element, dissimilar wall or partition or other vertical penetration;
    - .3 Construction changes within the plane of the partition or ceiling;
    - .4 Partition or furring run exceeds 10 m (30');
    - .5 Ceiling dimensions exceed 15 m (50') in either direction with perimeter relief, 10 m (30') in either direction without.
    - .6 Wings of "L", "U", and "T" shaped ceiling areas are joined;
    - .7 Expansion or control joints occur in the base exterior wall.
  - .5 Line up control joints with joints in other construction or with center lines of mullions, columns, piers, or similar building elements, and where accepted by Consultant.
  - .6 Install control joints straight and true.

- .7 Ceiling height door frames may be used as control joints. Less than ceiling height frames should have control joints extending to ceiling from both corners. If control joints are not used, additional reinforcement is required at corners to distribute concentrated stresses.
- .8 Construct through wall control joints at fire-rated assemblies in accordance with fire-rated assemblies in accordance with assembly listing requirements.
- .2 Expansion joints:
  - .1 Provide expansion joints in gypsum board elements located at building expansion joints.
  - .2 Unless otherwise shown, form expansion joint by terminating gypsum board edged with casing bead on both sides of joint and backed by minimum 2.5 mm thick aluminum plate fastened on one side only. Fabricate to align with adjacent floor expansion joint cover.
- .3 Relief joints:
  - .1 Provide relief joints where indicated and where gypsum board assemblies abut dissimilar construction.
  - .2 Where indicated, provide other mouldings, reveals, and feature strips. Install in accordance with manufacturer's directions, plumb, level, accurately aligned at joints, and securely fastened to supporting work.
  - .3 At exterior wall, where gypsum board abuts curtainwall, window, and door frames, provide isolation tape between casing bead and frame.

### **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.
- .6 Construct non-rated fire separations to same requirements as rated assembly but use standard gypsum board.

### **3.12 ACCESS DOORS**

- .1 Install access doors to mechanical and electrical fixtures specified in respective sections.
- .2 Install access doors supplied by Mechanical and Electrical Divisions and as specified in Section 08 31 00 - Access Doors and Frames in locations determined by coordination with trades installing mechanical, electrical, and other building services and consultation with Consultant.
- .3 Rigidly secure frames to furring or framing systems.
- .4 Some access panels require gypsum board infill, coordinate with electrical and mechanical for type and location.

### **3.13 FINISHING**

- .1 Gypsum Board Finish Levels: finish gypsum board walls and ceilings to following levels in accordance with Gypsum Association GA-214, Recommended Levels of Gypsum Board Finish:
  - .1 Levels of finish – General Instructions:
    - .1 Level 1 for non-exposed areas: Embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable and for plenum areas above ceilings, in attics or in concealed spaces.
    - .2 Level 2: Embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable and when gypsum is used as a substrate for tile.
    - .3 Level 3: Embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges and where areas are to receive a heavy coating of textured material.
    - .4 Level 4 for exposed areas: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges and where light textures or wall coverings are to be applied.
    - .5 Level 5: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges. Use this level of finish for the following board types where a painted finish is required:
      - .1 Mould-resistant glass mat faced paperless board;
      - .2 Cementitious board;
      - .3 Non-cementitious backer board.
  - .2 Vacuum clean after sanding to remove sanding dust, ready for prime coat and finish painting.

### **3.14 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.15 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.16 BOARD SCHEDULE**

- .1 Refer to Drawings for general requirements for partitions and walls; the additional requirements noted below are part of Contract and are required:
  - .1 Use fire rated Type C and Type X board as required at fire rated wall and ceiling assemblies, meeting OBC requirements. Refer to fire-rating listed on Drawings to establish locations.
  - .1 Mould-resistant glass mat faced paperless board: use at walls, except where tile backer board, cementitious board or abuse-resistant board is specified. Use also at ceilings of shower enclosures.
  - .2 Abuse-resistant board: to 2440 mm above finished floor at all walls at Rooms 108, 109, 114, 121, 122, 123, and 124. Install Mould-resistant glass mat faced paperless board above 2440 mm.
  - .3 Type C Fire Rated Board: F-3 mezzanine floor assembly.
  - .4 Standard board: ceilings, except at shower enclosures and F-3 mezzanine floor assembly.
  - .5 Cementitious board: shower walls.
  - .6 Non-cementitious backer board: wall tile locations, except at shower walls.
  - .7 Other Work as indicated and required for a complete installation.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 – Structural Metal Stud Framing.
- .2 Section 05 50 00 – Metal Fabrications.
- .3 Section 07 92 00 – Joint Sealants.
- .4 Section 09 21 16 – Gypsum Board Assemblies.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - .2 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM C645-18, Standard Specification for Nonstructural Steel Framing Members.
  - .4 ASTM C754-20, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2 CSA Group (CSA)
  - .1 CSA S16:24, Design of steel structures.
  - .2 CSA S136-16, North American specification for the design of cold-formed steel structural members.
  - .3 CSA S304:24, Design of Masonry Structures.
- .3 National Association of Architectural Metal Manufacturers (NAAMM)
  - .1 ANSI/NAAMM HMMA 840-16, Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames.

**1.3 PERFORMANCE REQUIREMENTS**

- .1 System Design: Design and size components in accordance with CSA S136 to withstand dead and live loads as calculated in accordance with OBC.
  - .1 Loads: In accordance with OBC with Post-Disaster Importance Factor and Seismic Site Class D criteria.
  - .2 Refer to and comply with the requirements of Section 01 11 00 Summary of Work, item 1.7 POST-DISASTER BUILDING.
- .2 Maximum deflections under specified wind loads shall conform to the following:
  - .1 Interior wall studs supporting masonry veneer shall meet the requirements of CSA S304.1, with veneer deflections limited to L/600 or with stud deflections limited to L/720.
  - .2 Interior wall studs supporting other finishes = L/360.
- .3 Design to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges. Design wind bearing stud end connections to accommodate floor/roof deflections such that the studs are not loaded axially.
- .4 Conform to the requirements of specified fire rated and sound rated assemblies.



- .5 Provide bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress effects due to torsion between lines of bridging. Do not rely on sheathing to resist torsion or minor axis buckling.
- .6 Design assembly to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
- .7 Design door support assemblies to accommodate suspended loads, deflection of building structural members, and clearances of intended sliding door openings.
- .8 Connections between lightweight steel framing members shall be bolts, welding or sheet metal screws.
- .9 Resistances for sheet metal screws shall be based on the manufacturer's lower bound test values multiplied by the appropriate resistance factor given in CSA S136.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and data sheet for each product specified.
- .3 Shop Drawings:
  - .1 Submit Shop Drawings showing elevations, sections, and details of construction.
  - .2 Refer to and comply with the requirements of Section 01 11 00 Summary of Work, item 1.7 POST-DISASTER BUILDING.
  - .3 Delegated Design Requirements:
    - .1 For suspended ceiling applications, fire resistive rated walls, and for walls exceeding 3050 mm in height, locations with two or more thicknesses of gypsum board, acoustical ceilings with 1 layer or more of gypsum board, and securement of ceiling mounted fixtures and components, submit shop drawings designed and sealed by a Professional Engineer (P.Eng.) licenced to practice in the Province of Ontario, showing elevations, plans, sections, and details, including engineering calculations.
    - .2 Refer to Drawings for additional engineering requirements
    - .3 Submit confirmation of stud thicknesses and spacings to suit spans and conditions as required to satisfy OBC and L/240 maximum deflection.

#### **1.5 QUALITY ASSURANCE**

- .1 Delegated Design: Contractor shall engage the services of a Professional Engineer (P.Eng.) licenced to practice in Ontario to design and seal Shop Drawings requiring structural design.
- .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

**Part 2 Products**

**2.1 CEILING SUPPORT MATERIALS AND SYSTEMS**

- .1 General: Size ceiling support components to comply with ASTM C754 and OBC unless otherwise indicated.
- .2 Ceiling Grid Suspension System: direct-hung system composed of interlocking main beams and cross-furring members, to ASTM C645 and follows:
  - .1 Protective Coating: to ASTM C645 and ASTM A653/A653M Z180 hot dipped galvanized. ZF120 galvanized products are not acceptable.
  - .2 Concrete Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to five times design load indicated in ASTM C635/C635M, Table one, Direct Hung. Select from one of the following types:
    - .1 Cast-in-place anchors.
    - .2 Post installed expansion anchors.
    - .3 Chemical anchors.
    - .4 Powder actuated fasteners, except that they shall be sized for ten times the design load indicated above.
  - .3 Rod and Flat Hanger: Mild steel, zinc coated.
  - .4 Hangers, Braces and Ties: steel wire, galvanized minimum 2.78 mm (12 ga.) Ø or greater as required for support of ceiling components.
  - .5 Tee Bar Grid Size: Double web construction, minimum 0.45 mm thickness x 38 mm face width x 43 mm high, and 24 mm face width x 38 mm high as appropriate to manufacturer's standard details, having a knurled flange [and pre-cut facets at 203 mm O/c for radiused installations].
  - .6 Hat Furring Channel: 1220 mm long x 22 mm deep. Minimum metal base thickness [0.45] [0.79] mm.
  - .7 Wall Mouldings:
    - .1 Hemmed Angle Moulding: 32 mm high with 32 mm flange.
    - .2 Unhemmed Channel Moulding: 19 mm x 40 mm x 32 mm flange.
  - .8 Clips: Include adaptor clips, gypsum board attachment clips, angle clips, cross tee clips and other mouldings and trims necessary for a complete installation.
  - .9 Screws and Fasteners: Bugle head screws in accordance with thickness of material used and the provisions of Section 09 21 16 - Gypsum Board Assemblies.
  - .10 Structural Classification: Post-Disaster Importance Factor and seismic Site Class D, design assembly and connections to structure in accordance with reviewed engineered Shop Drawings, ASTM C635/C635M, and as follows:
    - .1 Classification requires wires to be closer together for additional loading as per reviewed engineered Shop Drawings.
    - .2 Deflection of fastening suspension system supporting light fixtures, ceiling grilles, access doors, verticals and horizontal loads shall have a maximum deflection of L/360 of the span.
  - .11 Acceptable Manufacturers:
    - .1 Armstrong World Industries Canada Ltd.
    - .2 CertainTeed Ceilings.
    - .3 CGC Inc.

## 2.2 MATERIALS

- .1 Maximum permitted deflection:  $L/240$ .
- .2 Coordinate with other trades as required.
- .3 At partition walls that enclose wet areas (e.g., showers, kitchenettes, and similar) and at plumbing walls, steel studs shall have a metallic coating that conforms to ASTM A653/A653M with a minimum metallic coating weight (mass) of Z275.
  - .1 At other locations, steel studs shall have a metallic coating that conforms to ASTM A653/A653M with a minimum metallic coating weight (mass) of Z120.
- .4 Refer to interior partition types on Drawings and reviewed engineered Shop Drawings for minimum stud sizes and spacings, modified as follows:
  - .1 Design Thickness, to CSA S136, and Stud Spacing:
    - .1 Non-rated Partitions: fabricated from minimum 0.478 mm thick material (Design Thickness). (Steel framing gauge for reference only: 25 gauge);
      - .1 High Span Requirements: Provide 0.84 mm thick (20 gauge) stud framing at high span areas where span requires thicker stud framing materials.
    - .2 Requirements for locations with Cementitious Board or High-Impact Gypsum Board (Abuse Resistant Board), fire-rated and non-rated: Provide 0.84 mm thick (20 gauge) stud framing.
    - .3 Fire-Rated Partitions: fabricated from minimum 0.84 mm thick material.
    - .4 At wall-mounted millwork and cabinetry, acoustical panels, toilet accessories, storage shelving, furniture and equipment, kitchen equipment and services, and other items requiring blocking and support to resist loads, supply and install the following as required to provide adequate support to resist loads:
      - .1 Backer Plates: 150 mm wide x 1.2 mm thick (minimum) steel backer plates in wall cut to fit and fixed to studs as required.
      - .2 Space studs at 300 mm on centre, or less as required.
    - .5 Provide double stud framing at jambs.
- .5 Steel Studs: hot dipped galvanized steel; roll formed with knurled flanges, services and bracing cut outs.
- .6 Knock-out service holes at 460 mm centres.
- .7 Runners: Width, gauge and galvanizing to match steel studs, and as follows:
  - .1 Double Runner Deflection Track: Outside runner using 50 mm flanges; inner runner 33 mm; maintaining 25 mm minimum deflection space.
  - .2 Slotted Deflection Track for Fire Separations: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced at 25 mm on centre along length of runner; tested and certified for use in fire rated wall construction:
    - .1 Standard of Acceptance:
      - .1 Brady Construction Innovations, SliptrackSystems
      - .2 Dietrich Metal Framing, SLP-TRK
    - .2 Base Runner: Bottom track with 33 mm upstanding legs.
- .8 Gypsum board furring channels: 0.75 mm core thickness galvanized steel channels for screw attachment of gypsum board.

- .9 Resilient clips and channels as required: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .10 Acoustical sealant: to Section 07 92 00.
- .11 Insulating strip: rubberized, moisture resistant 3 mm thick cork or foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.
- .12 Fasteners for Metal Framing: Type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- .13 Horizontal and Vertical Shaft Liner Framing System: to ASTM C645 manufacturer's standard shaft wall steel framing system having ASTM A653/A653M, Z180, hot-dip galvanized zinc coating; minimum steel thickness of 0.84 mm thick (20 gauge) or heavier as required by detailed design required for indicated spans; including head and bottom rails, channels, trim and accessories required for a complete installation:
  - .1 Acceptable materials:
    - .1 Shaftwall Systems (CT Studs, J-Tabbed Tracks), by Bailey Metal Products Limited.
    - .2 C-H Stud Framing System, CGC Inc.
    - .3 C-T Stud Framing System, Georgia-Pacific Canada, Inc.
    - .4 Series IV – I Studs, CertainTeed.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 Stud end bearing shall be a minimum of 25 mm.
- .2 Limiting heights shall be calculated using ICC-ES AC86.
- .3 Non-structural sections shall comply with ASTM C645.
- .4 Meet the requirements of the reviewed engineered Shop Drawings and OBC.

#### **3.2 ERECTION**

- .1 Install steel studs to ASTM C754, reviewed engineered Shop Drawings, and OBC.
- .2 Runners/tracks are to be isolated from concrete using an Insulating Strip; the only locations to use an isolation coating is to separate dissimilar metals.
- .3 Predrill holes for gypsum board installation where stud material thickness is too great to accept typical self-tapping screw installation methods.
- .4 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .5 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .6 Place studs vertically at 400 mm on centre, or as otherwise indicated or specified elsewhere in this Section, and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross-brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .7 Erect metal studding to tolerance of 1:1000.
- .8 Attach studs to bottom track using screws; allow for 25 mm deflection at top track, or as otherwise stipulated by the structural drawings.

- .9 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs, ensure web openings are aligned.
- .10 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .11 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .12 Install 1.438 mm thick (Design Thickness) single jamb studs at openings.
- .13 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .14 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .15 Provide 40 mm stud or backer plates secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .16 Install steel studs or backer plates between studs for attaching electrical and other boxes.
- .17 Extend partitions full height to underside of structure above (with allowances for structural movement) except where noted otherwise on drawings, or as otherwise required by OBC.
- .18 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks. Use double track slip joint as indicated.
- .19 Install continuous insulating strips to isolate studs from uninsulated surfaces and all concrete surfaces.
- .20 Install two continuous beads of acoustical sealant or continuous insulating strip under studs and tracks around perimeter of sound control partitions.
- .21 Unless otherwise indicated, partitions, together with gypsum board facings, shall extend above ceilings to underside of structural slab or deck above.
- .22 Maintain clearance to avoid transference to structural loads to studs.
- .23 At fire rated and sound rated partitions, offset framing around beams and, if necessary, around ductwork running above top of partitions in order to maintain required separation.
- .24 At locations where partitions extend higher than 420 mm, provide diagonal stud framing to laterally brace partition framing above ceilings.
- .25 Lateral Support Bracing Channels:
  - .1 Stiffen partitions over 3 meters in vertical span at mid-height to maximum vertical spacing of 2400 mm on centre with at least one 19 mm horizontal bracing channel extending full length of partition, overlapping at least two stud spaces at ends of bracing channels. Secure bracing to stud framing.
  - .2 Stiffen partitions at not more than 150 mm from the top and bottom of openings and across two full stud spaces at each side of openings with horizontal bracing channel.

- .26 Blocking:
  - .1 Attach adequate baker plates to framing as required to support the load of, and to withstand the withdrawal and shear forces imposed by, items stalled upon the work of this Section, including but not necessarily limited to the following conditions:
    - .1 Washroom accessories.
    - .2 Cabinet work and finish carpentry.
    - .3 Miscellaneous specialties.
    - .4 Additional items indicated to be mounted on gypsum board partitions.

### 3.3 **INSTALLATION: CEILING SUPPORT MATERIALS AND SYSTEMS**

- .1 Install in accordance with reviewed engineered Shop Drawings and OBC.
- .2 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.
- .3 Keep lateral braces at hangers back 450 mm (18") unless otherwise noted.
- .4 Space hangers at 914 mm (36") on centre maximum along runner channels, and not more than 150 mm (6") from ends.
- .5 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.
- .6 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.
- .7 Attach to rod hangers by bending hanger sharply under bottom flange of runner, and securely wiring in place with saddle tie.
- .8 Where hangers are suspended from steel roof deck, make holes through both sides of deck troughs and pass hanger wire through and down both sides of trough. Wrap around vertical hanger rod.
- .9 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.
- .10 Secure furring channels to each support with purpose-made slips or wire tie. Splice joints by lapping channels and tying together.
- .11 Install proprietary ceiling systems in accordance with manufacturer's printed directions.
- .12 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft.).
- .13 Where ductwork, piping, and other elements within ceiling spaces interfere with direct suspension of ceiling from structure, install additional framing securely fastened to main structure to accommodate proper hanging of ceiling.
- .14 Erect exterior soffit framing in accordance with reviewed shop drawings. Suspend soffit framing with metal studs and brace system to withstand positive and negative wind pressures without detrimental effects. Fasten furring members to surrounding walls. Use minimum 1.2 mm thick framing members.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.6 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 03 35 10 – Concrete Floor and Slab Finishing.
- .2 Section 07 92 00 – Joint Sealants.
- .3 Section 09 21 16 – Gypsum Board Assemblies.
- .4 Section 09 65 00 – Resilient Flooring.
- .5 Section 10 51 13 – Metal Lockers.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)
  - .1 ANSI A108/A118/A136.1:2024, American National Specifications for the Installation of Ceramic Tile.
  - .2 ANSI A118.3-2013, Specifications for Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive.
  - .3 ANSI A118.4-2019, Specifications for Modified Dry-Set Cement Mortar.
  - .4 ANSI A118.5-1999 (R2021), Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation.
  - .5 ANSI A118.7-2019, Specifications for High Performance Cement Grouts for Tile Installation
  - .6 ANSI A118.11-2017, Standard Specifications for EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar.
  - .7 ANSI A137.1:2022, American National Standards Specifications for Ceramic Tile.
  - .8 ANSI A326.3 – 2017, American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials.
- .2 ASTM International (ASTM)
  - .1 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .2 ASTM C144-24, Standard Specification for Aggregate for Masonry Mortar.
  - .3 ASTM C150/C150M-24, Standard Specification for Portland Cement.
  - .4 ASTM C207-24, Standard Specification for Hydrated Lime for Masonry Purposes.
  - .5 ASTM C627-18, Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester.
  - .6 ASTM C979/C979M-24, Standard Specification for Pigments for Integrally Coloured Concrete.
  - .7 ASTM D226/D226M-17, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 25.20-95, Surface Sealer for Floors. (Withdrawn)
  - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction. (Withdrawn)
  - .3 CAN/CGSB 75.1-M88, Tile, Ceramic. (Withdrawn)
- .4 CSA Group



- .1 CSA-A3000-18, Cementitious materials compendium.
- .2 CSA/ASC B651:23, Accessible design for the built environment.
- .5 International Organization for Standardization (ISO)
  - .1 ISO 13007:2020, Ceramic Tiles- Grouts and Adhesives.
- .6 South Coast Air Quality Management District (SCAQMD), California State:
  - .1 SCAQMD Rule 1168-2017, Adhesives and Sealants Applications.
- .7 Terrazzo Tile and Marble Association of Canada (TTMAC)
  - .1 Tile Specification Guide 09 30 00, 2019-2021, Tile Installation Manual.
  - .2 Hard Surface Maintenance Guide.
- .8 Tile Council of North America (TCNA)
  - .1 2021 TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.
- .9 ULC Standards
  - .1 CAN/ULC-S102.2- 2018, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Preconstruction Meeting: Arrange a preconstruction meeting attended by Contractor, Consultant, tile installer, tile supplier, and mortar and grout representative to discuss the following:
  - .1 Substrate and backing surfaces flatness requirements.
  - .2 Installation techniques associated with specified materials.
  - .3 Compatibility between specified materials and between adjacent materials.
  - .4 Concerns arising from site conditions.
  - .5 Concerns of installers or suppliers arising from as-constructed conditions.

### **1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Include manufacturer's information on:
    - .1 Ceramic tile, marked to show each type, size, and shape required.
    - .2 Bond coats.
    - .3 Mortar and grout.
    - .4 Divider strips.
    - .5 Levelling compound.
    - .6 Waterproofing/crack isolation membrane.
    - .7 Fasteners.
- .3 Samples:
  - .1 Tile: Submit actual tile samples illustrating colour, texture, size and pattern for each type of tile specified.
  - .2 Grout: Submit manufacturer's full range of colours available for each type of grout specified.

- .3 Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, colour, and size.
- .4 Adhere tile samples to 11 mm thick plywood and grout joints to represent project installation.

## **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials
  - .1 Provide minimum 10% of each type and colour of tile required for project for maintenance use. Store where directed.
  - .2 Maintenance material same production run as installed material.

## **1.6 QUALITY ASSURANCE**

- .1 Installer Qualifications: Specializing in tile work having minimum of five years successful documented experience with work comparable to that required for this project. Installer must be registered as a member in good standing with the Terrazzo, Tile and Marble Association of Canada.
- .2 Conform to requirements of Terrazzo, Tile and Marble Association of Canada (TTMAC), Tile Specification Guide 09 30 13 - Tiling, Tile Installation Manual.
- .3 Obtain each type of tile material required from single source. For colour consistency, ensure the supplier has capacity to provide products from the same production run, dye lot, calibre and batch number.
- .4 Obtain setting and grouting materials from one manufacturer to ensure compatibility.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver materials in containers with labels legible and intact and grade-seals unbroken.
- .2 Store materials to prevent damage or contamination.
- .3 Store materials in a dry area, protected from freezing, staining and damage.
- .4 Store cementitious materials on a dry surface.

## **1.8 SITE CONDITIONS**

- .1 Surfaces for tile installation must be clean, dimensionally stable, cured, level, plumb and free of contaminants such as oil, sealers and curing compounds.
- .2 Maintain air temperature and structural base temperature at ceramic tile installation area above 12°C for 48 hours before, during, and 48 hours after, installation. Tile and setting material stored at same conditions 48 hours before and seven days after application.
- .3 Do not install tiles at temperatures less than 12°C or above 38°C.
- .4 Do not apply epoxy mortar and grouts at temperatures below 15°C or above 25°C.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Factory blend tile that exhibits colour variations within the ranges selected and package, therefore tile units taken from one package show the same range in colours as those taken from other packages.

- .2 Provide tile products manufactured in accordance with CAN/CGSB 75.1 or ANSI A108.1 as appropriate to the Standard of Acceptance materials.
- .3 Performance Requirements:
  - .1 Dynamic Coefficient of Friction: Tile installed on walkway surfaces having following values as determined by testing identical products per ANSI A326.3:
    - .1 Level Surfaces: Minimum 0.42.
    - .2 Ramp Surfaces: Minimum 0.46.
  - .2 Load-Bearing Performance: Provide installations rated for the following load-bearing performance in accordance with ASTM C627 for ceramic tile installed on walkway surfaces:
    - .1 Heavy: Passes cycles 1 through 12.
  - .3 Floor Level Tolerances: Provide materials to attain floor levelness tolerances required by this Section and as required by TTMAC; calculate quantity of materials based on the difference between the specified tolerance and the initial tolerance specified in Section 03 35 00 - Concrete Finishing; measurements will be made in the same manner as used in Section 03 35 00 - Concrete Finishing.

## **2.2 WALL TILE**

- .1 CERAMIC WALL TILE #1 (CWT1): (WASHROOM AND SHOWER WALLS) CERAMIC WALL TILE, 100X400, (BELTILE RAINBOW SERIES BY CENTURA, COLOR: WHITE, FL416WG GLOSSY).
- .2 CERAMIC WALL TILE #2 (CWT2): (WASHROOM WALLS) CERAMIC WALL TILE, 200X1220, (OUDH BY CENTURA, COLOR: LAOS, OU 05 SP).
- .3 GLASS WALL TILE #1 (GWT1): (KITCHEN BACKSPLASH), GLASS WALL TILE, 50X300, (MIKI GLASS BORDER BY CENTURA, COLOR: WARM GREY, OPUS581212).

## **2.3 FLOOR TILE**

- .1 PORCELAIN FLOOR TILE#1 (PFT1): (SHOWER FLOORS), PORCELAIN FLOOR TILE, 50X50, (MIKI TECHNO BY CENTURA, COLOR: OCHER GRANITE, MBU22204)
- .2 PORCELAIN FLOOR TILE#2 PFT2: (VESTIBULE FLOORS)PORCELAIN FLOOR TILE, 300X600, (PORTOBELLO LAB SERIES BY CENTURA, COLOR: ASH NATURAL, 900059E).

## **2.4 TILE BASE**

- .1 PORCELAIN BASE TILE#1 (PBT1): (WASHROOM BASE) PORCELAIN BASE TILE 100X400- (STROMBOLI BY CENTURA – COLOR: SAVASANA MATTE - ST25892).
- .2 PORCELAIN BASE TILE#2 (PBT2): (VESTIBULE BASE TO BE SAME AS VESTIBULE FLOOR (PFT2).

## **2.5 MORTAR, GROUT, AND ADHESIVE MANUFACTURERS**

- .1 Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following manufacturers:
  - .1 Ardex Americas.
  - .2 Custom Building Products Ltd.
  - .3 Flextile Ltd.
  - .4 Laticrete International Inc.

.5 MAPEI Inc.

## **2.6 MORTAR AND ADHESIVE MATERIALS**

- .1 Mortar to be of the following properties unless otherwise specified:
  - .1 Cement: Grey meeting requirements of CSA A3000.
  - .2 Sand: to ASTM C144, passing 16 mesh.
  - .3 Latex additive: formulated for use in cement mortar and thin set bond coat.
  - .4 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.
- .2 Polymer Modified Mortar – floor tile: Modified non-sagging dry-set cement mortar with polymer for large and heavy tile thin-set applications, complying with ANSI A118.4, ANSI 118.11 and ISO 13007 C2TES1P1:
  - .1 Standard of Acceptance:
    - .1 X5, Ardex.
    - .2 Versabond LFT, Custom Building Products.
    - .3 56SR Mortar, Flexile Ltd.
    - .4 4-XLT, Laticrete International Inc.
    - .5 Ultraflex LFT, MAPEI Inc.
- .3 Thin Set Interior Wall: Dry set mortar meeting or exceeding the requirements of ANSI A118.1 formulated for thin set applications of ceramic biscuit tile, factory sanded mortar consisting of Portland cement, sand and additives requiring only potable water to be added for installation [complete with ANSI A118.4 bond enhancing latex additives].
  - .1 Standard of Acceptance:
    - .1 VersaBond LFT Professional Mortar, Custom Building Products.
    - .2 4-XLT, Laticrete International Inc.
    - .3 Ultraflex LFT, MAPEI Inc.
- .4 Showers:
  - .1 All tile in the identified rooms shall be installed with a dry-set cement mortar meeting the requirements of ANSI A118.15. The mortar shall be applied using the thin-set method directly to the waterproofing membrane.
  - .2 Standard of Acceptance:
    - .1 CustomBuilding Products MegaLite® Ultimate Crack Prevention Mortar.
    - .2 Mapei Granirapid System.
    - .3 Schluter shower system.

## **2.7 GROUT**

- .1 Colours: As selected by Consultant.
- .2 Colouring Pigments:
  - .1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C979.
  - .2 Colouring pigments to be added to grout by manufacturer.
  - .3 Job coloured grout not acceptable.

- .3 Ready-to-Use Grout: Professional-grade, ready-to-use colour consistent quartz aggregate, for use with grout joints 1.5 to 12 mm.
  - .1 Colour: as selected by Consultant, confirm colour with Consultant prior to ordering materials.
  - .2 Acceptable Materials:
    - .1 Fusion Pro Component Grout, Custom Building Products.
    - .2 ColorMax Plus, Flextile Ltd.
    - .3 Spectralock 1, Laticrete International Inc.
    - .4 Flexcolour CQ, MAPEI Inc.
- .4 Fast-Curing, Polymer-Modified Colourfast Sanded Grout: Cement/sand compound, factory blended, polymer-modified, fast-curing efflorescence free grout; comply with ANSI A118.7 and ISO 13007 Classification CG2WAF.
  - .1 Compressive Strength: 3000 psi at 24 hours.
  - .2 Colour: as selected by Consultant, confirm colour with Consultant prior to ordering materials.
  - .3 Acceptable Materials:
    - .1 Prism Ultimate Performance Grout, Custom Building Products.
    - .2 1600 RSG Fast Setting PM Sanded Grout, Flextile Ltd.
    - .3 Permacolor Select, Laticrete International Inc.
    - .4 Ultracolor Plus FA fast-curing, colorfast HCT Grout, MAPEI Inc.
- .5 Grout for shower rooms, kitchen/servery areas and other wet room areas:
  - .1 Epoxy Grout: Multi-component, factory prepared, 100 percent epoxy resin and hardener with sand or mineral filler material; product shall exceed ANSI A118.3, ANSI 118.3 and ISO 130007 Classification RG for industrial grade. Must be manufactured for use in locations where mould and mildew resistance are requirements along with resistance to frequent cleaning with anti-bacterial cleaners.
  - .2 Standard of Acceptance:
    - .1 Kerapoxy IEG Commercial Grade Water-Cleanable Epoxy Grout, MAPEI Inc.

## **2.8 CRACK ISOLATION MEMBRANE**

- .1 Acceptable Materials:
  - .1 Crack Buster Pro Crack Prevention Mat with Peel & Stick Primer, Custom Building Products.
  - .2 Flexilastic 1000 Crack Isolation Membrane with 4000 Primer, Flextile Ltd.
  - .3 Fracture Ban, Laticrete International Inc.
  - .4 Mapeguard 2, MAPEI Inc.
- .2 Accessories: supply all primers and accessories as required for a complete installation.

## **2.9 WATERPROOFING MEMBRANE SYSTEM**

- .1 Integrated bonded waterproofing system (polyethylene core with polypropylene fleece laminated to both sides for tiled showers:
- .2 Standard of Acceptance:
  - .1 Schluter® Shower System including the following:
    - .1 Schluter®-KERDI (showers).
    - .2 Schluter®-KERDI-DS.
    - .3 KERDI accessories as required, including KERDI-BAND, KERDI-FLEX, KERDI-KERS-B, KERDI-KERS, KERDI SEAL-PS and MV, KERDI-FIX, pre-formed KERDI KERECK-F corners; KERDI-DRAIN and KERDI-LINE linear drain (coordinate drain with mechanical trades); refer to TTMAC Method 326DR.
    - .4 Application Equipment: KERDI-TROWEL.
    - .5 Backer Board: cement board, to Section 09 21 16 Gypsum Board Assemblies.

## **2.10 ACCESSORIES**

- .1 Refer to Drawings A8.1 and A10.1 for edge and transition profile requirements. Finish shall be brushed stainless steel.
- .2 Profiles shall be sized to suit conditions.
  - .1 Conform to applicable requirements of adjoining floor and wall tile.
  - .2 Use trim shapes sizes conforming to size of adjoining field wall tile unless specified otherwise.
- .3 Control Joints: Rigid PVC anchoring legs and side sections, Schluter as selected by Consultant. Thickness to suit tile, colour to later selection. Install at slab control joints.
- .4 Joint Sealant: in accordance with Section 07 92 00 – Joint Sealants.

## **2.11 PATCHING AND LEVELLING**

- .1 Patching and Levelling: to Section 09 06 23 – Common Work Results for Flooring Preparation.

## **2.12 CLEANING COMPOUNDS**

- .1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- .2 Materials containing acid or caustic material are not acceptable.

## **2.13 CLEAR PENETRATING SEALERS**

- .1 Provide clear matt finish penetrating sealers as recommended by tile manufacturer compatible with their tiles, mortar and adhesives and suitable for site conditions and locations.
- .2 Treat floor and wall tiles as recommended by the tile manufacturer.
- .3 Sealers for floors must be specifically designed to not reduce the slip-resistance performance of the floor tile.

- .4 Test tiles with sealer first to ensure that no discolouration occurs and provide to Consultant for review before ordering products and proceeding with sealer work.

## **2.14 TEMPORARY FLOOR PROTECTION**

- .1 Standard of Acceptance:
  - .1 Ram Board Plus®, by Ram Board, Inc., plus manufacturer's recommended accessories.
  - .2 or equivalent temporary protection mat.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 CONCRETE SUBSTRATES**

- .1 Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with flooring.
  - .1 Roughen concrete substrates as follows:
    - .1 Mechanically profile surfaces with an apparatus that abrades the concrete surface to a profile as specified by system application guide.
    - .2 Comply with ASTM C811 requirements unless manufacturer's written instructions are more stringent.
  - .2 Repair damaged and deteriorated concrete according to tile manufacturer's written instructions.
  - .3 Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
    - .1 Perform anhydrous calcium chloride test, ASTM F1869. Proceed with application of flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
    - .2 Perform plastic sheet test, ASTM D4263. Proceed with application only after testing indicates absence of moisture in substrates.
    - .3 Perform relative humidity test using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
  - .4 Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

### **3.3 PREPARATION**

- .1 Wall Surfaces:
  - .1 Roughen previously painted surfaces having hard glossy finish by sandpaper or other abrasive medium, and completely remove finishes which are not

- compatible with compounds specified under this section, and that are to be in contact with such objectionable finishes.
- .2 Remove all foreign matter such as loose mortar, plaster, visible laitance, cement, form release agents, dust and the like which would otherwise impede bonding of leveling coat or mortars.
- .3 Prime very dry gypsum, wood or porous concrete with primer, brush or roller applied at full strength in accordance with adhesive manufacturer's recommendations.
- .4 Provide a leveling coat over substrate as required to eliminate surface irregularities and provide for a uniform, smooth and plumb tiled wall surface, within required tolerances.
- .2 Floor Surfaces:
  - .1 Completely remove oil, grease, waste and all other contaminants from floor areas scheduled to receive new ceramic tile.
  - .2 Mechanically or chemically (using trisodium phosphate or similar material) remove all paints, adhesives or other previously applied compounds to expose clean surface of existing concrete substrate. Do not use any acids.
  - .3 Leveling Underlayment: Where substrate varies beyond limitations as set forth hereinafter, prime substrate, mix and apply underlayment in accordance with manufacturer's instructions.
  - .4 Concrete shall be minimum of 28 days old.
  - .5 Wire brush steel substrates to remove deleterious substances and rust, to promote full adhesion to steel.
  - .6 Provide leveling coat where required to bring surfaces to true even plane within 1:1000. Allow leveling coat to completely cure prior to installation of tile finish.
  - .7 Provide thick dry pack mortar bed where required to raise level of base prior to tile installation. Slope top surface to drains.

### 3.4 INSTALLATION – GENERAL

- .1 Perform tile work in accordance with TTMAC Tile Installation Manual except where specified otherwise in this Section.
- .2 Comply with applicable Building Code and CSA/ASC B651.
- .3 Apply tile or backing coats to clean and sound surfaces.
- .4 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.
- .5 Maximum surface tolerance 1:800.
  - .1 After 2-day cure-period, Consultant will measure flatness of applications for adherence to specified tolerances using standard straight edge method; non-compliant work shall be re-done as required by Contractor at Contractor's expense.
- .6 Make joints between tile parallel, uniform and approximately 1.5 mm wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.
- .7 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .8 Provide accent patterns as shown, or if not shown, as directed by Consultant.



- .9 Provide mortar bed to slopes and thicknesses required to meet level of adjacent floors
- .10 Bond tiles to substrate in accordance with mortar/adhesive manufacturer's directions. All floor tiles are to be 100% back buttered.
- .11 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .12 Make internal angles square, external angles rounded.
- .13 Use bullnose edged tiles at termination of wall tile panels, except where panel abuts projecting surface or differing plane.
- .14 Install divider strips at junction of tile flooring and dissimilar materials.
- .15 Allow minimum 24 hours after installation of tiles, before grouting.
- .16 Clean installed tile surfaces after installation and grouting cured.
- .17 Provide tile manufacturer's standard trim pieces at changes in direction and at terminations. Unless otherwise indicated provide the following corner and edge conditions:
  - .1 Internal horizontal corners: coved.
  - .2 External vertical and horizontal corners and edges: Bull nose.
  - .3 Internal vertical corners and unexposed edges: Square butt joint.
- .18 Provide metal edge trim at junction of floor tiles with other flooring materials.
- .19 Provide metal edge trim at wall tile outside corners (vertical) and exposed edges of wall tiles.
- .20 Install prefabricated control and movement joints in tile Work in accordance with applicable TTMAC details to suit installation indicated and site conditions, and as follows:
  - .1 Locate control joints at control joints in substructure.
  - .2 Locate movement joints as per ANSI A108/A118/A136.1 and the following table, unless specifically indicated otherwise on the Contract Drawings:

Environment	Minimum	Maximum	Joint Width
Interior	4880 mm	6100 mm	6 mm
Interior/Sunlight	3660 mm	4880 mm	6 mm
Exterior/Normal	2440 mm	3660 mm	10 mm
Exterior/Excessive	2440 mm	3050 mm	13 mm
  - .3 Provide control joints at inside corners, changes in plane, and where tile abuts dissimilar materials. Install a joint sealant at these open tile joints. Keep building control and movement joints free of mortar and grout.
  - .4 Interior Movement Joint Widths:
    - .1 At perimeter joints at perimeter walls, joint width shall be minimum 6 mm.
    - .2 At other perimeter joints, preferred joint width shall be at a least 6 mm but never less than 3 mm.
    - .3 At changes in plane, preferred joint width shall be at least 6 mm but never less than 3 mm.

### 3.5 CRACK ISOLATION MEMBRANE – INSTALLATION

- .1 Location: Provide crack isolation membrane at cracks in concrete floor.

- .2 Compliance: install system in accordance with the manufacturer's published preparation and installation instructions.
- .3 Limitations:
  - .1 Do not use over cracks or control joints subject to out-of-plane movement, or subject to in-plane movement greater than 10 mm. Note: refer to the "Expansion and Control Joints" section. If these conditions are found, notify the Consultant and wait for instructions before proceeding.
  - .2 Do not use crack isolation system with solvent-based materials.
  - .3 Do not use self-leveling products over crack isolation system.
  - .4 Do not use premixed products to set tile over crack isolation system.
- .4 Surface Preparation: as specified by membrane manufacturer.
- .5 Application:
  - .1 Apply system (primer and sheet membrane) in accordance with the system manufacturer's published instructions.
- .6 Expansion Joints:
  - .1 Do not cover any substrate expansion joints with crack isolation membrane, mortar or tiles.
  - .2 Provide for expansion joints where specified.
  - .3 When necessary, cut tiles along both edges of the expansion joints. Do not allow tiles and mortar to overlap the joints.
  - .4 Protect tiles with metal strips (edge metal) along both edges of structural building expansion joints.
  - .5 Install specified compressible bead and sealant into all expansion and control joints; refer to Section 07 92 00 - Joint Sealants.

### **3.6 WATERPROOFING MEMBRANE SYSTEM**

- .1 Install waterproofing membrane system in accordance with system manufacturer's published installation instructions, standard details, data sheets and specifications.
- .2 Locations: at tiled areas at showers.
- .3 Comply with waterproofing membrane manufacturer's requirements.
- .4 Prepare surfaces and install tile to TTMAC 321SR.

### **3.7 INSTALLATION OF WALL TILE**

- .1 Install tile on gypsum board or cement board as indicated, to TTMAC details 305W and/or 306W as applicable to conditions.
- .2 Large-format tile: comply with the applicable recommendations of TTMAC 330LFTW.
- .3 100% back butter all tile at time of installation.
- .4 Grout tile as specified.

### **3.8 INSTALLATION OF FLOOR TILE**

- .1 Install tile on concrete floor substrates, to TTMAC detail 309F, 310F and/or 311F as applicable to conditions. All tiles shall be installed over a properly levelled floor. The sequence from slab up is: slab, levelling materials, mortar, tiles.

- .2 Large-format tile: comply with the applicable recommendations of TTMAC 329 LFT; all large-format floor tile shall be installed over a properly levelled floor, with anti-fracture membrane installed underneath the tiles. The sequence from slab up is: slab, levelling materials, anti-fracture membrane, mortar, tiles.
- .3 100% back butter all tile at time of installation.
- .4 Grout tile as specified.

### **3.9 INSTALLATION OF TILE BASE**

- .1 Install as Indicated.
- .2 100% back butter all tile at time of installation.
- .3 Grout tile as specified.

### **3.10 SPECIAL ACCESSORIES**

- .1 Install transitions, edge protection, control joints, and other accessories in the tile work in accordance with manufacturer's specifications. Use longest lengths practical.
- .2 Install rubber wheelchair transition strips at transitions to dissimilar flooring materials, including concrete floors and resilient flooring or carpet; colour selected by Consultant. Refer to Section 09 65 00 Resilient Flooring.

### **3.11 FLOOR SEALER AND PROTECTIVE COATING**

- .1 Apply in accordance with manufacturer's instructions.

### **3.12 FIELD QUALITY CONTROL**

- .1 After 2-day cure-period, Consultant will sound tiles, and any hollow-sounding tiles shall be replaced at Contractor's expense.
- .2 After 2-day cure-period, Consultant will measure flatness of applications for adherence to specified tolerances using standard straight edge method; non-compliant work shall be re-done as required by Contractor at Contractor's expense.
- .3 Manufacturer's Field Services:
  - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.13 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.14 PROTECTION**

- .1 Leave finished installation clean and free of cracked, chipped, broken, unbonded, or other tile deficiencies:

- .1 Protect finished areas from traffic until setting materials have sufficiently cured in accordance with TTMAC requirements.
- .2 Protect floor areas from traffic after grouting is completed in accordance with manufacturer's written instructions.
  - .1 Keep traffic off floors for a minimum of 72 hours after completion of grouting.
  - .2 Use stepping boards where access is required for light foot traffic only after 24 hours from completion of grouting.
  - .3 Do not immerse in water for minimum 21 days after completion of tile work.
- .2 Provide protective covering until Substantial Performance of the Work.
- .3 Protect wall tiles and bases from impact, vibration, heavy hammering on adjacent and opposite walls for a minimum of 14 days after installation.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 09 21 16 – Gypsum Board Assemblies.
- .2 Division 23 – HVAC
- .3 Division 26 - Electrical

**1.2 REFERENCES**

- .1 ASTM International (ASTM):
  - .1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2 ASTM C635/C635M-17, Standard Specifications for Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
  - .3 ASTM C636/C636M-19, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
  - .4 ASTM E580/E580M-20, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
  - .5 ASTM E1264-19, Standard Classification for Acoustical Ceiling Products.
  - .6 ASTM E1477-98a (2017) e1, Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 SDS - Safety Data Sheets.
- .4 ULC Standards (ULC):
  - .1 CAN/ULC-S102-2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

**1.3 ADMINISTRATIVE REQUIREMENTS.**

- .1 Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

**1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet for each product specified.
- .3 Submit shop drawings:
  - .1 Refer to and comply with the requirements of Section 01 11 00 Summary of Work, item 1.7 POST-DISASTER BUILDING.

- .2 Shop Drawings: Layout and details of acoustical ceilings. Show locations of items which are to be coordinated with, or supported by, the ceilings. Shop Drawings shall be designed, sealed and signed by delegated design engineer (P.Eng.).
- .3 Attachments to structure shall be designed by a delegated design professional engineer (P.Eng.) licenced to practice in the Province of Ontario.
- .4 The geotechnical engineer has recommended that the site be classified as "Site Class D" for structural design purposes in the absence of a site-specific dynamic analysis.
  - .1 Design, erect and install ceiling assemblies to meet OBC requirements for Class D seismic conditions, or as otherwise determined by a professional engineer (P.Eng.) licensed to practice in the Province of Ontario based on OBC calculations.
- .5 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .4 Samples:
  - .1 Submit duplicate 100 x 100 mm samples of each type of acoustical unit.
  - .2 Include accessories and mitered interior and exterior corners of wall mouldings.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials
  - .1 Provide extra materials of acoustic units in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide acoustical units amounting to 10% of gross ceiling area for each pattern and type required for project.
  - .3 Ensure extra materials are from same production run as installed materials.
  - .4 Clearly identify each type of acoustic unit, including colour and texture.
  - .5 Deliver to Consultant, upon completion of the work of this Section.

## 1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements:
  - .1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Single-Source Responsibility: Provide perimeter trim components, panels and grid components by a single manufacturer.
- .3 Mock-Ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .2 Construct mock-up 10 m<sup>2</sup> minimum of each type of acoustical panel ceiling including one inside corner and one outside corner.
  - .3 Construct mock-up where directed.
  - .4 Allow 24 hours for inspection of mock-up by Consultant before proceeding with ceiling work.
  - .5 When accepted, mock-up will demonstrate minimum standard for this work. Reviewed mock-up may remain as part of the finished work.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and as follows:
  - .1 Protect on site stored or installed absorptive material from moisture damage.
  - .2 Store extra materials required for maintenance, where directed by Consultant.

## **1.8 SITE CONDITIONS**

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20-40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

## **1.9 WARRANTY**

- .1 Provide manufacturer's standard limited warranty.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Standard of Acceptance materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
  - .1 Acoustic Panels:
    - .1 Armstrong World Industries Canada Ltd.
    - .2 CertainTeed.
    - .3 CGC Inc.
    - .4 Rockfon.
  - .2 Suspension Systems:
    - .1 Armstrong World Industries Canada Ltd.
    - .2 CertainTeed.
    - .3 CGC Inc.
    - .4 Chicago Metallic / Rockfon.

### **2.2 PERFORMANCE/DESIGN CRITERIA**

- .1 Maximum deflection: 1/360th of span to ASTM C635/C635M deflection test.

### **2.3 CEILING PANEL MATERIALS**

- .1 Acoustic Panels: conforming to ASTM E1264.
  - .1 Sizes: 610 x 610 mm.
  - .2 Thickness: 19 mm (3/4 inch).
  - .3 Material: Mineral fiber.
  - .4 Surface Finish: Factory applied latex paint.
  - .5 Edges: Bevelled tegular.
  - .6 Colour: White.

- .7 Texture: fine, fissured.
- .8 Noise Reduction Coefficient (NRC): 0.70.
- .9 Fire Class (CAN/ULC S102): Class A.
- .10 Light Reflectance (LR): 0.85.
- .11 Acceptable material:
  - .1 Cirrus 589 by Armstrong World Industries.

## 2.4 SEISMIC SUSPENSION SYSTEM

- .1 Components:
  - .1 Provide all materials, ancillary products and accessories meeting manufacturer's seismic code compliant selections and recommendations.
  - .2 All main beams and cross tees shall be commercial quality hot-dipped galvanized steel, to ASTM A653. Main beams and cross tees shall be double-web steel construction with 15/16-inch (23.8 mm) type exposed flange design. Exposed surfaces shall be factory-chemically cleansed, capping pre-finished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
- .2 Structural Classification: seismic.
- .3 Basic materials for suspension system: commercial-quality, cold rolled steel, zinc coated.
- .4 Suspension system: exposed tee bar grid width as appropriate for materials specified.
- .5 Rated for high humidity locations and clean room applications in appropriate locations, as indicated on Drawings or as recommended by acoustic tile manufacturer based on room function and use.
- .6 Acceptable Materials: materials to match products specified, use only materials from same manufacturer of panel products (colour: to match tiles, or as otherwise selected by Consultant from manufacturer's full range), and as follows:
  - .1 Acceptable Materials:
    - .1 DX/DXL, CGC, A USG Company.
    - .2 15/16" Classic, CertainTeed.
    - .3 Prelude XL, Armstrong.
- .7 Attachment Devices: Size for five times design load indicated in ASTM C635, Table 1, Direct Hung unless otherwise indicated.
- .8 Hanger wire: galvanized soft annealed steel wire:
  - .1 3.6 mm diameter for access tile ceilings.
  - .2 2.78 mm diameter for other ceilings.
- .9 Hanger inserts: purpose-made.
- .10 Accessories: splices, clips, wire ties, retainers and wall moulding to complement suspension system components, as recommended by system manufacturer.
- .11 Edge Mouldings and Trim: Metal or extruded aluminum of types and profiles indicated, or if not indicated, manufacturer's standard molding for edges and penetrations, including light fixtures, which fit type of edge detail and suspension system indicated. Provide moldings with exposed flange of the same width as exposed runner.
  - .1 Provide Axiom Classic Trim and accessories, as indicated, by Armstrong, or similar with same appearance and function, and same or better physical properties and performance characteristics.



- .2 Provide edge mouldings fabricated to diameter required to fit circular penetrations exactly.
- .3 Provide edge mouldings and trims that match width and configuration of exposed runners including the following configurations:
  - .1 Sheet Metal Fillers: Light zinc coated sheet steel finished to match T-bar
  - .2 Shadow Mould: Rolled sheet metal, one piece, having 19 mm x 13 mm flange and reveal
  - .3 Wall Mould: Channel or angle shape with a 25 mm or 22 mm exposed face.
  - .4 Wall mouldings at round columns: Extruded aluminum with white finish to match ceiling grid, Fry Column Collar for acoustic ceilings with white PVC spacer.
- .12 System Accessories:
  - .1 Hold-Down Clips for Wind Uplift (at or near entrances and where panels may be subject to wind uplift as directed by Consultant): Provide hold down clips spaced 610 mm  $O/C$  on all cross tees for interior ceilings consisting of acoustic panels weighing less than 4.88 kg/m<sup>2</sup>.
  - .2 Impact Clips (at areas where panels may be subject to impact based on intended room use, as directed by Consultant): provide manufacturer's standard impact clip system designed to absorb impact forces against acoustic panels.
  - .3 Sealant: to Section 07 92 00, for use in exposed locations, colour to match ceiling grid.
  - .4 Movement and expansion joints: "Z" shaped metal trim pieces.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Do not install acoustical panels and tiles until work above ceiling has been reviewed by Consultant.

#### **3.2 INSTALLATION OF SUSPENSION SYSTEM**

- .1 Comply with manufacturer's recommendations for Class D seismic installations.
- .2 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636, Cisca installation standards and any other applicable national or local code requirements. Make allowance for seismic, thermal and structural movement.
- .3 Install suspension system to Certification Organizations tested design requirements.
- .4 Do not erect ceiling suspension system until all mechanical and electrical work above ceiling has been inspected by Consultant.
- .5 Secure hangers to overhead structure using attachment methods acceptable to Consultant.
- .6 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
- .7 Lay out centre line of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width.
- .8 Ensure suspension system is co-ordinated with location of related components.

- .9 Install wall moulding to provide correct ceiling height.
- .10 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers grilles and speakers.
- .11 Support at light fixtures and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .12 Interlock cross member to main runner to provide rigid assembly.
- .13 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .14 Expansion joints:
  - .1 Supply and install "Z" shaped metal trim pieces at each side of expansion joint. Design to accommodate plus or minus 25 mm movement and maintain visual closure. Finish metal components to match adjacent exposed metal trim. Provide backing plates behind butt joints.

### **3.3 INSTALLATION OF ACOUSTIC PANELS**

- .1 Install acoustic panels and tiles in ceiling suspension system.

### **3.4 APPLICATION**

- .1 Refer to reflected ceiling plan.
- .2 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.
- .3 Touch up cut edges with manufacturer-supplied paint.

### **3.5 SYSTEM INTEGRATION**

- .1 Coordinate ceiling work to accommodate components of other Sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.8 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C423-22, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data: For each type of fabric facing, panel edge, core material, and mounting indicated.
- .2 Shop Drawings:
  - .1 Refer to and comply with the requirements of Section 01 11 00 Summary of Work, item 1.7 POST-DISASTER BUILDING.
  - .2 Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling and ceiling intersections. Indicate panel edge and core materials. Include elevations showing panel sizes and pattern matching.
  - .3 Attachments to structure shall be designed by a delegated design professional engineer (P.Eng.) licenced to practice in the Province of Ontario.
  - .4 The geotechnical engineer has recommended that the site be classified as "Site Class D" for structural design purposes in the absence of a site-specific dynamic analysis.
    - .1 Design, erect and install ceiling assemblies to meet OBC requirements for Class D seismic conditions, or as otherwise determined by a professional engineer (P.Eng.) licensed to practice in the Province of Ontario based on OBC calculations.
  - .5 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .3 Samples:
  - .1 Assembled Panels: Representative sample, approximately 300 by 300 mm, including each edge profile, corner, and finish; joints and mounting methods; mounting devices.
- .4 Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - .1 Items penetrating or covered by sound-absorbing ceiling units.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Extra Materials: provide one carton of baffles along with one set of replacement mounting system hardware and accessories.
- .2 Maintenance Data: For sound-absorbing ceiling units to include in maintenance manuals. Include manufacturers' written cleaning and stain-removal recommendations.

**1.4 QUALITY ASSURANCE**

- .1 Source Limitations: Obtain sound-absorbing ceiling units from single manufacturer.
- .2 Surface-Burning Characteristics to CAN/ULC S102.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Comply with fabric and sound-absorbing ceiling unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- .2 Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

## **1.6 SITE CONDITIONS**

- .1 Environmental Limitations: Do not install sound-absorbing ceiling units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- .2 Lighting: Do not install ceiling covering until a permanent level of lighting is provided on the surfaces to receive ceiling covering.
- .3 Air-Quality Limitations: Protect sound-absorbing ceiling units from exposure to airborne odours and install units under conditions free from odour contamination of ambient air.
- .4 Field Measurements: Verify locations of sound-absorbing ceiling units and actual dimensions of openings and penetrations by field measurements before fabrication.

## **1.7 WARRANTY**

- .1 Submit manufacturer's standard limited warranty.

## **Part 2 Products**

### **2.1 ACOUSTIC CEILING BAFFLES**

- .1 At #103 corridor and #115 training room, supply and install acoustic baffles, arranged on angles; refer to Drawings for details and further information.
  - .1 Standard of Acceptance Colour/Pattern:
    - .1 EzoBord, Colour: Classic White (CW04).
- .2 **ACB-1** (2440 long x 305 high x 12 mm thick): EzoBord as distributed by Ayrsonics Inc., McKyntire Group, or Feltworks Blades – VarAffix, by Armstrong World Industries.
- .3 **ACB-2** (3660 long x 305 high x 12 mm thick): EzoBord as distributed by Ayrsonics Inc., McKyntire Group, or Feltworks Blades – VarAffix, by Armstrong World Industries.

### **2.2 SEISMIC SUSPENSION SYSTEMS**

- .1 Structural Classification: Seismic Site Class D and Post-Disaster Importance Factor.
- .2 Provide all materials, ancillary products and accessories meeting manufacturer's seismic code-compliant selections and recommendations.
- .3 Supply manufacturer's mounting hardware as required for a complete installation meeting OBC and reviewed engineered Shop Drawings.

### **2.3 FABRICATION**

- .1 General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warping and damage.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Examine fabricated units, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing ceiling units.
- .2 Do not erect ceiling suspension system until work above ceiling including anchors, blockings, sound and fire barriers, mechanical and electrical work has been reviewed.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- .1 Measure each ceiling area and establish layout of acoustical panels to confirm placement and spacing of panels.
- .2 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, and other components to be built into ceiling system.

**3.3 INSTALLATION**

- .1 Comply with reviewed engineered Shop Drawings, and acoustic panel manufacturer's published instructions for installation of units using type of mounting devices required for the location and conditions. Mount units securely to supporting substrate.
- .2 Handle panels with clean gloves to avoid marring and damage to finish.
- .3 Establish mounting elevations using laser level.
- .4 Install square, true, level and plumb, evenly spaced as shown on Drawings..

**3.4 INSTALLATION TOLERANCES**

- .1 Variation from Plumb and Level:  $\pm 1.5$  mm.

**3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.7 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 92 00 – Joint Sealants.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM F710-19e1, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
  - .2 ASTM F1861-21, Standard Specification for Resilient Wall Base.
  - .3 ASTM F1869-16a, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
  - .4 ASTM F2170-19a, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- .2 CSA Group (CSA):
  - .1 CSA/ASC B651, Accessible design for the built environment
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 SDS - Safety Data Sheets.
- .4 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1113-16, Architectural Coatings.
  - .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .5 ULC Standards
  - .1 CAN/ULC-S102.2-2018, Standard Method of Test for Surface Burning Characteristics of Floor Coverings and Miscellaneous Materials and Assemblies.

**1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit one copy of product data for each type of product specified.
  - .2 Submit WHMIS SDS - Safety Data Sheets for flooring adhesive. Indicate VOC content.
- .2 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit duplicate manufacturer full-width samples of resilient wall base.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions in accordance with Section 01 78 00 – Closeout Submittals.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials
  - .1 Provide extra materials of resilient flooring and adhesives in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide 10% of each colour, pattern and type of flooring material required for project for maintenance use.
  - .3 Provide one full tread/riser unit.

- .4 Extra materials one piece and from same production run as installed materials.
- .5 Deliver to Owner upon completion of the work of this Section.
- .6 Store where directed by Consultant.

## **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements: Provide products that meet requirements of CAN/ULC-S102.2 as applicable for required flame spread ratings; labelled and listed by Underwriters Laboratories of Canada (ULC), or another testing and inspecting agency acceptable to authorities having jurisdiction.
- .2 Provide preparation, materials, and workmanship in accordance with NFCA requirements as detailed in the latest (online) edition of the NFCA Floor Covering Reference Manual of Canada, ([www.floorcoveringreferencemanual.com](http://www.floorcoveringreferencemanual.com)) and the material manufacturer's written recommendations for conditions of work and guarantee periods stated.
- .3 Qualifications: Provide proof of qualifications when requested by Consultant:
  - .1 Source Limitations: Obtain each type, colour, and pattern of flooring or accessories specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials in good conditions to the jobsite in manufacturer's original unopened containers that bear name and brand of manufacturer, project identification, and shipping and handling instructions.
- .3 Store materials in clean, dry, enclosed space off ground, and protect from weather and extremes of heat and cold. Protect adhesive from freezing. Store flooring, adhesives, and accessories in spaces where they will be installed for at least 48 hours before beginning installation.

## **1.8 SITE CONDITIONS**

- .1 Maintain air temperature and structural base temperature at flooring installation area above 20°C for 48 hours before, during and 48 hours after installation.

## **1.9 WARRANTY**

- .1 Provide Manufacturer's Warranty for product to be free from manufacturer defects for period of five years from date of substantial performance.

## **Part 2 Products**

### **2.1 RESILIENT WALL BASE**

- .1 Resilient wall base: to ASTM F1861, thermoplastic rubber.
  - .1 Type: TP, Group 1.
  - .2 Style:
    - .1 Straight or coved profile as selected by Consultant.
  - .3 Thickness: 2.0 mm (0.080 inch).
  - .4 Height: 102 mm (4 inches).

- .5 Supply in continuous rolls.
- .6 Acceptable material:
  - .1 Armstrong World Industries.
  - .2 Roppe Corporation.
  - .3 Tarkett Johnsonite.
- .7 Colours: As selected by Consultant from manufacturer's full range.

## **2.2 INTEGRATED ONE-PIECE RESILIENT TREAD-RISER**

- .1 Supply integrated one-piece resilient tread-riser system for stairs complete with contrasting colour anti-slip nose. Size and width as required to suite stairs.
  - .1 Acceptable Manufacturers:
    - .1 Allstate Flooring.
    - .2 Armstrong World Industries.
    - .3 C.I. Takiron/Toli North America.
    - .4 Nora Rubber Flooring.
    - .5 Roppe Corporation.
    - .6 Tarkett Johnsonite.
    - .7 American Biltrite (Canada)

## **2.3 ACCESSORIES**

- .1 Transition strips:
  - .1 Thermoset rubber, smooth, in accordance with CSA/ASC B651, tapered profiles to suit nature of transition.
- .2 Sub-floor filler and leveller: as recommended by flooring manufacturer.
- .3 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Comply with manufacturer's published floor preparation and product installation instructions, standard details, data sheets and specifications.

### **3.2 EXAMINATION**

- .1 Install flooring and accessories after other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of flooring. Do not install flooring over concrete slabs until they are sufficiently dry to achieve bond with adhesive, in accordance with manufacturer's recommended bond and moisture tests.
- .2 Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring substrate.

### **3.3 INSTALLATION: STAIRS**

- .1 Finish stairs with one-piece tread-riser system, full width of stairs.
- .2 Adhere over entire surface and fit accurately.



### **3.4 INSTALLATION: RESILIENT BASE**

- .1 Lay out base to keep number of joints at minimum.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions.
- .7 Fit base at exterior and interior corners in accordance with manufacturer's recommendations and as follows:
  - .1 Internal corners: Butt and cope lip of base on one side.
  - .2 External corners: V-groove back of base, wrap around outside corners minimum 300 mm and bond to vertical surfaces with contact adhesive.

### **3.5 INSTALLATION: ACCESSORIES**

- .1 Install transition profiles at unprotected and exposed edges where materials terminate. Use adhesives as recommended by manufacturers.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 03 35 10 - Concrete Floor and Slab Finishing.
- .2 Section 07 92 00 - Joint Sealants.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D412-16(2021), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
  - .2 ASTM D624-00(2020), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
  - .3 ASTM D638-22, Standard Test Method for Tensile Properties of Plastics.
  - .4 ASTM D1864/D1864M-89(2023), Standard Test Method for Moisture in Mineral Aggregate Used on Built-Up Roofs.
  - .5 ASTM D2794-93(2024), Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
  - .6 ASTM D4060-25, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- .2 ULC Standards (ULC)
  - .1 ULC-S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies, 06/01/2018.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Convene pre-installation meeting one week prior to beginning work of this Section with Contractor, installer and affected trades present to review the following:
  - .1 Locations to receive waterproofing.
  - .2 Conditions that may affect the work.
  - .3 Manufacturer's installation instructions.
  - .4 Trade coordination.
  - .5 Warranty requirements.
  - .6 Constraints and schedule.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with requirements of Section 01 33 00 – Submittal Procedures.
- .2 Product Data: submit manufacturer's published product data sheets and application instructions for specified flooring system, or approved equivalent system.
- .3 Samples: Submit samples for initial selection of finish colour for approval before ordering materials.

**1.5 MAINTENANCE INSTRUCTIONS**

- .1 Submit maintenance instruction for incorporation in operation and maintenance manuals in accordance with the requirements of Section 01 78 00 - Closeout Submittals.

## **1.6 QUALITY ASSURANCE**

- .1 Provide work of this section only by an applicator who has adequate equipment and skilled workers to perform it expeditiously, is an applicator approved by Supplier of fluid-applied flooring materials, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years.
- .2 Subcontractor: manufacturer-certified installer with proven experience with specified system.
- .3 Quality control: Division 01 requirements and as follows.
  - .1 Verify by Tooke thickness gauge, and in the presence of Consultant, that thicknesses of complete fluid-applied flooring is in accordance with the Contract Documents.
  - .2 Manufacturer shall provide field review in accordance with Division 01 requirements.
- .4 Test Data: If requested, submit test data as directed and as follows:
  - .1 All test data submitted by the waterproofing system manufacturer shall be data generated by an independent testing laboratory and presented on the laboratory's own report forms and letterhead.
  - .2 Product tests shall be totally controlled by the testing laboratory. Specimens shall not be pre-treated by the manufacturer.
- .5 Mock-up:
  - .1 Construct 1.86 m<sup>2</sup> (20 ft<sup>2</sup>) mock-up panel of typical fluid-applied flooring system including base at the Place of the Work as part of final installation for review, location to be determined by Consultant.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Store materials at the Place of the Work in an area specifically set aside for purpose that is locked and ventilated. Maintain materials at minimum temperature of 16°C before use.
- .2 Ensure compliance with health and fire regulations during storage, handling, and application.
- .3 Deliver and store materials undamaged, in original containers, with manufacturer's labels and seals intact.

## **1.8 SITE CONDITIONS**

- .1 Coat surfaces only with surface temperatures at a minimum of 10°C for 72 hours before, during and following application, or until cured, when no dust is being raised, and in well-ventilated and broom clean areas.
- .2 Ensure substrate is sound, dry, free of dust, dirt, paint, grease, oil or other foreign substances.
- .3 Ensure adequate ventilation during installation.
- .4 Advise other Subcontractors or fixtures and fittings not to be installed until flooring is cured.
- .5 Protect adjacent surfaces from damage resulting from work of this section. If necessary, mask and/or cover adjacent surfaces, fixtures, equipment, and the like by suitable means.

- .6 Post "NO SMOKING" signs while work is in progress and curing.
- .7 Concrete substrate conditions:
  - .1 Concrete: clean, sound, compressive strength 20 MPa minimum, crack free and contain 3% maximum moisture content by mass.
  - .2 Concrete to be free from sealers or membrane curing agents or other foreign matter.
  - .3 Allow concrete to cure 28 days minimum before applying fluid-applied flooring.
  - .4 Concrete to have light steel trowel finish.
  - .5 Finish surfaces shall be level, or straight where sloped to drains. Variation in plane of substrate shall not exceed 1:500. Deviations or deteriorated concrete shall be repaired prior to start of work of this section.

## **1.9 PROTECTION**

- .1 Protect surfaces not intended to be waterproofed.

## **1.10 WARRANTY**

- .1 Provide manufacturer's 3-year warranty.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Manufacturers:
  - .1 Mapei: as specified.
  - .2 Sika: Sikafloor® PurCem® polyurethane cement flooring system, complete with all recommended products and accessories as required for a complete installation.
  - .3 Stonhard: Stonclad urethane flooring system, complete with all recommended products and accessories as required for a complete installation.
- .2 Single Source: provide a complete flooring system as manufactured and supplied by a single manufacturer.

### **2.2 STANDARD OF ACCEPTANCE**

- .1 Fluid-Applied Flooring System: 5 mm (3/16 inch) thick, slip-resistant flooring system.
  - .1 Coving screed: Polyurethane and cement based, for forming coves between floors and walls.
    - .1 Standard of Acceptance:
      - .1 Mapefloor CPU/COVE, by Mapei.
  - .2 Moisture barrier: 100% solids, epoxy.
    - .1 Standard of Acceptance:
      - .1 Planiseal MB, by Mapei.
  - .3 Primer: Two-component filled epoxy.
    - .1 Standard of Acceptance:
      - .1 Primer SN, by Mapei.

- .4 Aggregate: Washed and oven-dried silica sand.
  - .1 Standard of Acceptance:
    - .1 Mapesand Coarse, by Mapei.
- .5 Topcoat: Two-component aliphatic polyurethane topcoat, solvent-free.
  - .1 Standard of Acceptance:
    - .1 Mapefloor Finish 450, by Mapei.
- .6 Demarcation lines: two-component epoxy resin.
  - .1 Standard of Acceptance:
    - .1 Mapefloor 302 SL Epoxy Resin, by Mapei.
- .7 Colours: as selected by Consultant from manufacturer's full range.

## **2.3 CONTROL JOINT TREATMENT**

- .1 Supply flooring system manufacturer's two-component, polyurethane, elastomeric sealant system, meeting ASTM C920:
  - .1 Standard of Acceptance:
    - .1 Mapei Mapeflex P2 SL for flat surfaces, and Mapeflex P2 NS for sloped surfaces.
- .2

## **2.4 ACCESSORIES**

- .1 Concrete repair and patch materials: as recommended by the flooring manufacturer and compatible with their products.
- .2 Provide manufacturer's recommended concrete primer.
- .3 Floor drains: in accordance with Mechanical Divisions.
- .4 Sealant to expansion joints: in accordance with the requirements of Division 03; must be compatible with flooring system.
- .5 Sherwin Williams Pro Industrial Water-based Alkyd Urethane Enamel, or equivalent.

## **2.5 TEMPORARY FLOOR PROTECTION**

- .1 Standard of Acceptance:
  - .1 Ram Board Plus®, by Ram Board, Inc., plus manufacturer's recommended accessories.
  - .2 Equivalent temporary protection mat.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Comply with flooring manufacturer's published floor preparation and flooring system instructions, all related data sheets, and system installation specifications.

### **3.2 EXAMINATION**

- .1 Verify environmental and substrate conditions are suitable for application and curing before commencing work of this section.

- .2 Examine surfaces to receive fluid-applied flooring. Ensure surfaces are smooth, sound, dry and free from conditions that will adversely affect execution, performance, or quality of work.
  - .1 Test for moisture content in accordance with manufacturer's specifications and the following:
    - .1 Remove concrete chippings, wrap in vapour retardant plastic and deliver immediately to lab.
    - .2 Test in accordance with ASTM D1864.
- .3 Ensure that surfaces to receive fluid-applied flooring have been provided as specified in the work of other sections, that they will not adversely affect execution, performance, or quality of the work of this section, and that they can be put into acceptable condition by means of preparation specified in this section.
- .4 Provide clean, dry, and neutral Ph substrate for fluid-applied flooring.
- .5 Defective work resulting from application to unsatisfactory surfaces will be considered responsibility of those performing the work of this section.

### **3.3 NOTIFICATION**

- .1 Report deficiencies in writing to Consultant prior to commencing the work of this section.
- .2 Commencement of work shall imply acceptance of surfaces will be considered responsibility of those performing the work of this section.

### **3.4 PREPARATION**

- .1 Meet the requirements of the flooring system manufacturer's published floor slab preparation instructions. Prepare floors as required and as specified by the flooring system manufacturer
- .2 Thoroughly clean surfaces to receive coating by steel shot-blast, sandblast or other method in accordance with manufacturer's instructions.
- .3 Fill open control joints, and other cracks and voids with sand filled/epoxy mortar.
- .4 Clean, prime and seal surfaces as recommended by fluid-applied flooring manufacturer.
- .5 Rout or sawcut cracks exceeding 1.5 mm (1/16 inch) in width and fill with manufacturer's recommended sealant.
- .6 Advise other Subcontractors of fixtures, fitting and finishing not to be installed or started until decking is completed.
- .7 Traffic control: prohibit other Subcontractors from entry into areas during application and until surface has cured, and include protection after cure against damage by other Subcontractors.
- .8 Apply temporary protection of completed fluid-applied flooring as required.
- .9 Cover or mask surfaces adjacent to those receiving fluid-applied flooring to protect work of other sections and property from damage and soil.

### **3.5 APPLICATION**

- .1 General:
  - .1 Apply complete fluid-applied flooring system in accordance with the flooring system manufacturer's published application instructions.

- .2 Apply fluid-applied flooring 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.
- .3 Match colours and textures of accepted samples and mock-ups.
- .4 Make clean and true junctions with no visible overlap between adjoining applications of coatings.
- .5 Place cloths and other disposable coating materials that are a fire hazard in closed metal containers and remove from building at the end of each working day.
- .2 Provide integral coved base at upturns.
- .3 Uniformly broadcast non-skid aggregate at horizontal surfaces to refusal by "shake" method at a rate to provide a "medium" non-skid surface, and back-roll.
- .4 Apply second coat of topcoat for full coverage of first topcoat and aggregate.
- .5 Match finished work to accepted samples; uniform in thickness, sheen colour, texture and be free from defects detrimental to appearance or performance.
- .6 Seal waterproof flooring at floor drains.
- .7 Coordinate with Mechanical Division to ensure waterproof flooring is applied after curbs and floor mounted supports and prior to installation of equipment.

### **3.6 INTEGRAL COVE BASE**

- .1 Integral Cove Base: apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, of cove base. Round internal and external corners.
- .2 Caulk joint between floor and wall with a sealant acceptable to the flooring system manufacturer and compatible with their product.
- .3 Apply a coat of Sherwin Williams Pro Industrial Waterbased Alkyd Urethane Enamel, or equivalent, to wall surface that will receive the fluid-applied flooring integral cove base. Use painter's tape to ensure paint does not go beyond the bonding surfaces that will be coated. Allow paint to dry/cure before applying integral cove base.
- .4 Apply cove base with 25 mm (1-inch) radius, to height of 102 mm (4-inches) on vertical surfaces. Apply a continuous and even radius at floor transition. Apply base screed at termination of base.

### **3.7 TERMINATIONS**

- .1 Chase edges to "lock" the coating system into the concrete substrate along lines of termination.
- .2 Penetration Treatment: Lap and seal coating onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
- .3 Trenches: Continue coating system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
- .4 Treat floor drains by chasing the coating to lock in place at point of termination.

### **3.8 JOINTS AND CRACKS**

- .1 Treat sawcut control joints with manufacturer's recommended sealant.
- .2 Treat cold joints and construction joints to bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
- .3 Discontinue floor coating system at vertical and horizontal control and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

### **3.9 FIELD QUALITY CONTROL**

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- .2 Manufacturer's field services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Obtain reports within three days of review and submit.
- .4 Material Sampling: Owner may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.
  - .1 If testing is elected by Owner, Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
  - .2 Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
  - .3 If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

### **3.10 CURING**

- .1 Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 18 hours after application.

### **3.11 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.



**3.12 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.13 SCHEDULE**

- .1 Install as indicated at Apparatus Bays.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Apply paint as required and as indicated; refer to Drawings. Coordinate with other trades and sequence work of this Section in relation to other work as coordinated by Contractor.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D16-24, Standard Terminology for Paint, Related Coatings, Materials, and Applications.
- .2 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .3 Master Painters Institute (MPI)
  - .1 MPI Architectural Painting Specifications Manual.
- .4 National Fire Code of Canada.
- .5 Society for Protective Coatings (SSPC)
  - .1 SSPC Painting Manual.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Scheduling
  - .1 Submit work schedule for various stages of painting to Consultant for review. Submit schedule minimum of 48 hours in advance of proposed operations.
  - .2 Obtain written authorization from Consultant for changes in work schedule.
  - .3 Schedule painting operations to prevent disruption of and by other trades.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Health and Safety Requirements.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals shall meet the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Submit product data:
  - .1 Submit product data and instructions for each paint and coating product to be used.
  - .2 Submit product data for the use and application of paint thinner.
- .3 Submit samples:
  - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
  - .2 Submit duplicate 200 x 300 mm sample panels of each paint, stain, clear coating, and special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
    - .1 3 mm plate steel for finishes over metal surfaces.
    - .2 13 mm birch plywood for finishes over wood surfaces.

- .3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
  - .4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
  - .5 10 mm plywood for finishes over wood surfaces.
- .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
- .4 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, and include following information for each Product and colour incorporated into the Work:
  - .1 Product name, type and use.
  - .2 Manufacturer's product number.
  - .3 Colour number / formula code.
  - .4 MPI Environmentally Friendly classification system rating.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation and application instructions.
- .6 Submit quality assurance submittals in accordance with Section 01 45 00 - Quality Control.
  - .1 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
    - .1 Lead, cadmium and chromium: presence of and amounts.
    - .2 Mercury: presence of and amounts.
    - .3 Organochlorines and PCBs: presence of and amounts.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

## **1.5 QUALITY ASSURANCE**

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .1 Provide 3 m x 3 m mock-up. Prepare and paint designated surface, area, room or item (in each colour scheme) to specified requirements, with specified paint or coating showing selected colours, gloss/sheen, textures.
  - .2 Mock-up will be used to judge workmanship, substrate preparation, operation of equipment and material application and workmanship to MPI Architectural Painting Specification Manual standards.
  - .3 Locate where directed.
  - .4 Allow 24 hours for review of mock-up before proceeding with work.
  - .5 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

- .2 Acceptance at Site:
  - .1 Identify products and materials with labels indicating:
    - .1 Manufacturer's name and address.
    - .2 Type of paint or coating.
    - .3 Compliance with applicable standard.
    - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
  - .1 Provide and maintain dry, temperature controlled, secure storage.
  - .2 Store materials and supplies away from heat generating devices.
  - .3 Store materials and equipment in well-ventilated area with temperature range 7°C to 30°C.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Fire Safety Requirements:
  - .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
  - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
  - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

## 1.7 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces.
  - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
  - .3 Provide continuous ventilation for seven days after completion of application of paint.
  - .4 Coordinate use of existing ventilation system with Consultant and ensure its operation during and after application of paint as required.
  - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
  - .6 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Unless pre-approved written approval by Consultant and product manufacturer, perform no painting when:
    - .1 Ambient air and substrate temperatures are below 10°C.

- .2 Substrate temperature is above 32°C unless paint is specifically formulated for application at high temperatures.
  - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
  - .4 The relative humidity is above 85% or when the dew point is more than 3 degrees C variance between the air/surface temperatures. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
  - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
  - .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
- .2 Perform painting work when maximum moisture content of the substrate is below:
  - .1 12% for concrete and masonry (clay and concrete brick/block).
  - .2 15% for wood.
  - .3 12% for plaster and gypsum board.
  - .4 Allow new concrete and masonry to cure minimum of 28 days.
- .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
- .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
  - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
  - .3 Apply paint when previous coat of paint is dry or adequately cured.
- .4 Additional interior application requirements:
  - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
  - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Consultant such that painted surfaces will have dried and cured sufficiently before occupants are affected.
- .5 Additional exterior application requirements:
  - .1 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.
  - .2 Do not apply paint when:
    - .1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.
    - .2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.
    - .3 Surface to be painted is wet, damp or frosted.

- .3 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.
- .4 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.
- .5 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

## **1.8 EXTENT OF WORK**

- .1 Paint and finish "paintable" surfaces for area of the Work indicated in the Contract Documents, except those exempted by the Contract Documents.
- .2 The following surfaces are considered "non-paintable" for purposes of this Contract.
- .3 Omit painter's finishes from following items:
  - .1 Material and equipment furnished completely prime and finish painted by manufacturer.
  - .2 Internal surfaces of steel tanks and stacks;
  - .3 Intumescent fireproofing (unless otherwise specified or indicated).
  - .4 Exterior concrete including building walls, building floors and pavements, except as otherwise scheduled.
  - .5 Stainless steel, weathering steel, copper, bronze, chromium plate, nickel, anodized or lacquered aluminum, Monel metal (alloy composed of between 28 and 34 percent copper and minimum 63 percent nickel).
  - .6 Exposed insulation, glass, plastic, brick, stone, resilient floors, treads and bases, tile and hardware.
  - .7 Prefinished metals, unless required to be colour coded.
  - .8 Metallic and mastic insulation finishes.
  - .9 Abrasive material finishes on floors, stair treads, stair nosings and landings.
  - .10 Insulated electric cables.
  - .11 Machined parts of machinery and equipment.
  - .12 Concealed surfaces (except visible portions of inside of ductwork and louvers, etc.).

## **1.9 EXTRA MATERIALS**

- .1 Provide two sealed containers, each of four litres (one 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 the Place of the Work where directed by Owner.

## **1.10 WARRANTY**

- .1 Warranty period with regard to the work of this section is 2 years from date of Substantial Performance.
- .2 Throughout the warranty period, painting systems 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.

- .3 Presence of any of following during the warranty period 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.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Conform to latest MPI requirements for all painting work including preparation and priming.
- .4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI - Architectural Painting Specification Manual "Approved Product" listing.
- .5 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .6 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
  - .1 Non-flammable.
  - .2 Manufactured without compounds that contribute to ozone depletion in the upper atmosphere.
  - .3 Manufactured without compounds that contribute to smog in the lower atmosphere.
  - .4 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
- .7 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .8 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.
- .9 Surface coatings must not contain:
  - .1 Lead in excess of 600.0 ppm weight/weight total solids.
  - .2 Mercury in excess of 50.0 ppm weight/weight total product.
  - .3 Cadmium in excess of 1.0 ppm weight/weight total product.
  - .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
  - .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

### **2.2 COLOURS**

- .1 Basis-of-Design materials and colours: As selected by Consultant.
- .2 Second coat and third coat in a multicoat systems to be tinted slightly lighter colour than topcoat and each other to show visible difference between coats.

## 2.3 FINISHES

- .1 General: confirm gloss levels for all surfaces with Consultant before starting work. Unless otherwise specified, allow for:
  - .1 Ceilings: flat (G1).
  - .2 Walls: Eggshell (semi-gloss at service areas).
  - .3 Trim/frames: semi-gloss.
- .2 Paint mechanical equipment, ducts, piping which is exposed in all areas as directed by Consultant. Identification labelling by Division 22 and 23.

## 2.4 MIXING AND TINTING

- .1 Unless otherwise specified or pre-approved, all paint shall be ready-mixed and pre-tinted. Re-mix all paint in contained prior to and during application to ensure break-up of lumps, completed dispersion of settled pigment, and colour and gloss uniformity.
- .2 Mix paste, powder, or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.

## 2.5 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Description / Gloss Level	Gloss @ 60 degrees	Sheen @ 85 degrees
G1 - Matte Finish (flat)	Max. 5	Max. 10
G2 - Velvet-Like Finish	Max. 10	10 to 35
G3 - Eggshell Finish	10 to 25	10 to 35
G4 - Satin-Like Finish	20 to 35	min. 35
G5 - Traditional Semi-Gloss Finish	35 to 70	
G6 - Traditional Gloss	70 to 85	
G7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated or otherwise specified.

## 2.6 EXTERIOR PAINTING

- .1 All exterior painting work to be in accordance with MPI Premium Grade finish requirements. Refer to Schedules for instructions.
- .2 Asphalt Surfaces: zone / traffic marking for drive and parking areas, etc.
  - .1 EXT 2.1B - Alkyd zone / traffic marking finish.
- .3 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal:
  - .1 EXT 5.1P - Polyurethane, pigmented finish (over epoxy zinc rich primer).
- .4 Steel - High Heat: heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted:
  - .1 EXT 5.2A – Heat-resistant enamel finish.



- .5 Galvanized Metal: non-chromate passivated; high contact/high traffic areas (doors, frames, railings and handrails, etc.):
  - .1 EXT 5.3D – Polyurethane, pigmented finish (over vinyl wash and epoxy primer).
- .6 Bituminous Coated Surfaces: cast iron pipe, concrete, etc.:
  - .1 EXT 10.2A – Latex semi-gloss finish.
- .7 Exterior Wood Enclosures and Gates:
  - .1 EXT 6.2M – Latex satin or eggshell finish (over latex primer). Primer must be specifically formulated to be applied to pressure treated wood.

## **2.7 INTERIOR PAINTING**

- .1 All interior painting work to be in accordance with MPI Premium Grade finish requirements. Refer to schedules on Drawings to coordinate locations and determine finishes required.
- .2 Structural, electrical, and mechanical elements at exposed areas, including visible inside portions of ductwork and louvres, shall be primed and finish painted to MPI Premium Grade requirements.
- .3 Gloss level at all painted surfaces at ceilings and bulkheads to match; coordinate as required to achieve a consistent gloss level across different substrates.
- .4 Concrete block pigmented penetrating sealer, exposed:
  - .1 Standard of Acceptance:
    - .1 Sikagard® Color A-50 Lo-VOC, or equivalent. Colour as selected by Consultant from manufacturer's colour chart.
    - .2 Locations: to be applied over concrete masonry unit walls at rooms 117, 118 and 119, and as indicated.
- .5 Concrete block paint, exposed:
  - .1 Locations: exposed concrete unit masonry at locations where sealer is not being applied.
  - .2 INT 4.1L – High performance architectural latex semi-gloss finish.
- .6 Metal and prime painted structural steel and steel fabrications:
  - .1 INT 5.1R High performance architectural latex: G3 finish for locations at ceilings and bulkheads, and G5 finish at other locations.
    - .1 Shop prime painted and field finish painted. Do not shop prime locations requiring field welding, but prepare surfaces and field prime after welding.
- .7 Galvanized metal: Doors and door frames, galvanized metal railings and stairs.
  - .1 INT 5.3M – High performance architectural latex, G3 finish for locations at ceilings and bulkheads, and G5 finish at other locations.
    - .1 Shop prime painted and field finish painted. Do not shop prime locations requiring field welding or soldering, but prepare surfaces and field prime after welding.
- .8 Wood: Electrical backboards.
  - .1 INT 6.4PP – Fire retardant coating, pigmented, waterborne, MPI #64.
    - .1 CAN/ULC-S102 Flame spread rating Class A.

- .2 Apply in accordance with manufacturer's instructions. Apply to all six sides of plywood electrical backboards.
- .3 Colour: white.
- .4 Acceptable products: Fire Retardant Paint FR-110, by Incl-x, or equivalent from Great Northern Insulation, InnovProtect, or AD Fire Protection Systems.
- .9 Gypsum Board; walls and partitions, ceilings and bulkheads.
  - .1 INT 9.2B - High performance architectural latex:
    - .1 Walls: G4 finish.
    - .2 Ceilings and bulkheads: G3 finish.
- .10 Gypsum board assemblies – epoxy finish: at wet and humid areas, including but not necessarily limited to washrooms, kitchenettes, and janitor closets.
  - .1 INT 9.2N – Epoxy high build over latex sealer:
    - .1 Acceptable finish system: manufacturer's recommended primer/sealer plus Sherwin Williams MACROPOXY 646-100 FAST CURE EPOXY, or approved equivalent system.
- .11 Coating at gypsum board bonding surfaces where epoxy flooring integral cove base is being installed; coordinate with the requirements of Section 09 67 00 – Fluid Applied Flooring:
  - .1 Standard of Acceptance:
    - .1 Sherwin Williams Pro-Industrial Water based Alkyd Urethane Enamel, or approved equivalent.
- .12 Piping and ductwork, wrapped: Latex finish, INT 5.3M.
  - .1 Gloss: G3 finish for locations at ceilings and bulkheads, and G5 at other locations.
- .13 Galvanized metal (zinc coated steel) at exposed piping and conduit, unwrapped; Alkyd finish, INT 5.3L.
  - .1 Gloss: G3 finish for locations at ceilings and bulkheads, and G5 at other locations.
- .14 Bituminous coated surfaces: cast iron pipe, concrete, etc.:
  - .1 INT 10.2A - Latex G5 finish.

## **2.8 SOURCE QUALITY CONTROL**

- .1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.
  - .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
  - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
  - .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

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**Part 3            Execution**

**3.1            MANUFACTURER'S INSTRUCTIONS**

- .1      Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

**3.2            GENERAL**

- .1      Perform preparation and operations for interior and exterior painting in accordance with MPI - Architectural Painting Specifications Manual except where specified otherwise.
- .2      Apply paint materials in accordance with paint manufacturer's written application instructions.

**3.3            EXAMINATION**

- .1      Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2      Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3      Maximum moisture content as follows:
  - .1          Stucco, plaster, and gypsum board: 12%.
  - .2          Concrete: 12%.
  - .3          Wood: 15%.
  - .4          Clay and Concrete Block/Brick: 12%.
- .4      Check surfaces to determine if pH of surfaces meet manufacturer's requirements.
- .5      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.
- .6      Report in writing any condition adversely affecting this work.
- .7      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 all surfaces which could be detrimental to a satisfactory and acceptable finish.

**3.4            PREPARATION**

- .1      Prepare substrate surfaces in accordance with MPI Manual Premium Grade requirements including, but not limited to remaining items listed in this article.
- .2      Remove hardware and hardware accessories, electric plates, machined surfaces, lighting fixtures, other escutcheons and appurtenances and similar items already installed that are not to be painted:
  - .1          Provide surface applied protection before surface preparation and painting where removal is impractical or impossible because of size or weight of the item.
  - .2          Reinstall items removed using workers skilled in the trades involved after completing painting operations in each space or area.

- .3 Remove oil and grease then clean substrates of substances that could impair bond of the various coatings before applying paint or other surface treatments:
  - .1 Clean floors, adjacent surfaces and surfaces to be painted before work is commenced.
  - .2 Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
  - .3 Clean and prepare surfaces according to manufacturer's written instructions for each particular substrate condition and as specified.
- .4 Provide barrier coats over incompatible primers or remove and re prime substrate where trade contractor for this Section failed to adequately coordinate use of MPI Manual recommended primers and surface preparation techniques.
- .5 Prepare concrete, concrete unit masonry by removing efflorescence, chalk, dust, dirt, grease, oils, and release agents; roughen as required to remove glaze; mechanically remove hardeners or sealers used to improve curing; use solvent or mechanical cleaning methods that comply with SSPC recommendations appropriate to surface and exposure location:
  - .1 Exposed concrete and concrete block walls that are scheduled to be painted or sealed shall not be painted or sealed until sealants have been applied at control joints and joints with hollow metal frames.
  - .2 Thoroughly clean form oil, parting compounds, curing compounds and other incompatible materials from concrete surfaces.
  - .3 Thoroughly clean masonry and concrete surfaces to be painted free of mortar droppings, concrete spatter and extraneous matter.
  - .4 Use abrasive blast cleaning methods if recommended by paint manufacturer.
  - .5 Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application.
  - .6 Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
  - .7 Clean concrete floors with a 5% solution of muriatic acid or other etching cleaner; flush floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
- .6 Clean wood surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required and as follows:
  - .1 Sand surfaces exposed to view smooth and dust off before prime coat application. Putty nail holes and minimal cracks after primer has dried; sand between primer and topcoats with No. 300 sandpaper and remove dust.
  - .2 Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer.
  - .3 After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler, sand smooth when dried.
  - .4 Where wood elements are to be painted, stained or clear finished:
    - .1 Prime, stain, or seal wood to be painted immediately on delivery.
    - .2 Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
    - .3 Back prime with spar varnish where transparent finish is required.
    - .4 Back prime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.

- .7 Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances using solvent or mechanical cleaning methods that comply with SSPC recommendations appropriate to surface and exposure location:
  - .1 Clean unpainted and shop primed metal to provide satisfactory surfaces to receive overcoats and provide permanent adhesion of coatings. Remove rust and scale with emery paper and wire brushes. Thoroughly clean metal surfaces including piping and ductwork of oil and grease with mineral spirits.
  - .2 Remove loose paint and scale from shop primed metal work.
  - .3 Blast steel surfaces clean as recommended by paint system manufacturer.
  - .4 Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
  - .5 Prime bare metal, make good shop primed metal where abraded, feather out edges to make touch-up patches inconspicuous.
  - .6 Touch up bare areas and shop applied prime coats that have been damaged; wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as shop coat.
- .8 Clean galvanized surfaces with non-petroleum-based solvents so surface is free of oil and surface contaminants, mechanically remove pre-treatment materials from galvanized sheet metal fabricated from coil stock.
  - .1 Apply cold phosphate surface treatment to SSPC-PT2-82 to unpassivated zinc-coated metal.
  - .2 For passivated zinc-coated metal ("white rusted"), power wire brush or vigorously hand wire brush to scuff galvanize thoroughly, and solvent clean to SSPC-SP1-82.
  - .3 Prepare exterior exposed galvanized steel and galvanized steel at wet areas to SSPC-SP7 - Sweep Blast.
  - .4 For galvanized steel floor and roof deck in Natatorium and related adjacent service areas, supplement the above in accordance with Paragraph 3.9 of this section and finish coating system manufacturer's instructions and recommendations.
- .9 Gypsum Board:
  - .1 Ensure that gypsum board joints are smooth, and board is clean and free of jointing compound spatter.
  - .2 Test surfaces for alkalinity with pink litmus paper or other recognized method.
- .10 Mix and prepare paint materials according to manufacturer's written instructions:
  - .1 Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - .2 Stir material before application to produce a mixture of uniform density.
  - .3 Stir as required during application to maintain consistent tint density.
  - .4 Do not stir surface film into material, remove surface film and strain material before using.
  - .5 Use only thinners approved by paint manufacturer and only within recommended limits.
  - .6 Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied.

- .7 Tint undercoats to match the colour of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.
- .11 Shut down motors, fans, and mechanical ventilation systems during spray painting. Shut down air intakes in affected areas and ventilate to exterior, when applying noxious smelling or VOC containing paints and coatings.
- .12 Materials shall be thoroughly mixed before application and applied without cutting or admixture except as indicated in writing by the manufacturer.
- .13 Protect adjacent surfaces and areas from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means.
- .14 Correct, refinish or replace any damage caused by failure to provide adequate protection to adjacent surfaces.
- .15 Sand, clean, dry, etch, neutralize or test all surfaces using adequate illumination, ventilation and temperature requirements in accordance with manufacturer's written instructions and the MPI Manual.
- .16 Keep waste rags in covered metal drums containing water and remove from building at end of each day.

### **3.5 APPLICATION - PRIMERS**

- .1 Completely prime all surfaces of exterior wood to receive paints or coatings.
- .2 Apply primer coats to steel and galvanized steel surfaces that have and have not received shop coat or primer.
- .3 Finish and back prime all wood components prior to their installation.
- .4 When primer sealer is dry, touch up visible suction spots before the next coat is applied and do not proceed with the work until suction spots are sealed.
- .5 Apply primer in multiple layers if required for proper coverage and as required and recommended by finish coating manufacturer for the substrate involved.

### **3.6 APPLICATION**

- .1 Method of application to be as approved by Consultant. Apply paint by brush, roller, air sprayer or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
  - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
  - .2 Work paint into cracks, crevices, and corners.
  - .3 Paint surfaces and corners not accessible to brush using spray, daubers, or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers, or sheepskins.
  - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
  - .5 Remove runs, sags, brush marks from finished work, and repaint.
- .3 Spray application:
  - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

- .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
- .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
- .4 Brush out immediately all runs and sags.
- .5 Use brushes and rollers to work paint into cracks, crevices, and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .9 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .10 Finish closets and alcoves as specified for adjoining rooms.
- .11 Finish top, bottom, edges, and cut-outs of doors after fitting as specified for door surfaces.
- .12 Reseal cut edges of wood doors and seal unfinished tops and bottoms of wood doors with 3 coats polyurethane sealer. At wood doors with plastic laminate facing, paint edges of doors to match colour of plastic laminate, 1 coat of primer and 2 finish coats.
- .13 Grilles and perforated items shall be spray painted in a manner that does not block perforations. Apply evenly to present a consistent appearance free from defects visible from distance of 1.5 metres.

### **3.7 MECHANICAL/ELECTRICAL EQUIPMENT**

- .1 Unless otherwise specified or noted, paint all "unfinished" conduits, piping, hangers, ductwork and other mechanical and electrical equipment with color and texture to match adjacent surfaces, in the following areas:
  - .1 where exposed-to-view in all exterior and interior areas.
  - .2 in all interior high humidity interior areas.
  - .3 in all boiler room, mechanical and electrical rooms.
- .2 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .3 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .4 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .5 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .6 Do not paint over nameplates.

- .7 Keep sprinkler heads free of paint.
- .8 Paint inside of ductwork where and to the full extent visible behind grilles, registers, and diffusers with primer and minimum one coat of matt black paint.
- .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .10 Paint natural gas piping yellow.
- .11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .12 Do not paint interior transformers and substation equipment.
- .13 Coordinate painting of services with application of colour banding, flow arrows, and identification labels provided by mechanical and electrical Divisions.

### **3.8 PATCHING**

- .1 Do retouching to ensure that the work is handed over to the Owner in proper condition, free of runs, spatter, finger marks, rust, watermarks, scratches, blemishes or other disfiguration, with full, even coverage.

### **3.9 SITE TOLERANCES**

- .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

### **3.10 FIELD QUALITY CONTROL**

- .1 Where special painting, coating or decorating system applications (e.g., elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Consultant.
- .2 Advise Consultant when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .3 Cooperate with inspection firm and provide access to areas of work.
- .4 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Consultant.

### **3.11 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.



**3.12 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.13 SCHEDULE**

- .1 Finish Schedule:
  - .1 Assume full responsibility for painting or otherwise finish surfaces of all materials of the contract exposed in the finished work which do not already have finished surfaces and that normally require paint or varnish finish. Inspect surfaces over which the work of this section is dependent for unevenness, cracks, surface defects, moisture, cleanliness, roughness and other irregularities detrimental to the application and performance of the work. Confirm conditions satisfactory before proceeding. Failure in complying with above or failure to have unsatisfactory conditions corrected before proceeding, shall not relieve Contractor of responsibility for required results.
  - .2 Exposed means 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.
  - .3 Unless otherwise indicated, all exposed wood that is not prefinished is to receive a transparent finish. Prefinished wood items include:
- .2 In instances where materials specified are not suitable for particular application or are contrary to manufacturer's recommendations for use on particular surface, immediately bring to attention of Consultant for clarification and instructions.
- .3 Where finishing formula for surfaces requiring paint is not specified, follow recommendations of MPI Painting Specifications Manual, Premium.
- .4 Consultant shall have right to make changes in colour tone of finishes prior to final coat to obtain desired results without additional cost to Owner.
- .5 Unless otherwise noted or scheduled, walls shall be painted the same colour within a given area.
- .6 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.
- .7 In areas specifically designated as "unfinished" painting is not required except for bare, primed and zinc coated metal surfaces and insulated ductwork and pipes.
- .8 Where exposed to view paint bare metals, previously primed metals and zinc coated metals unless specified otherwise.
- .9 Paint electrical power and lighting panels, whether prefinished or not.
- .10 Coordinate with gypsum board assembly trades as required to ensure that a Level 5 board finish is applied for all gypsum board to be painted with semi-gloss, gloss or high-gloss paint.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 32 Specifications: asphalt paving and site concrete.
- .2 Refer to Drawings site sign requirements.

**1.2 REGULATORY REQUIREMENTS**

- .1 Ontario Ministry of Transportation (MTO) Ontario Traffic Manual.
- .2 County of Brant Sign By-Laws and regulations.

**1.3 REFERENCES**

- .1 The Aluminum Association Inc. (AA)
  - .1 AA ADM-2020, Aluminum Design Manual, 2020 Edition.
  - .2 AA DAF-45-2003 (R2009), Designation System for Aluminum Finishes
- .2 ASTM International (ASTM)
  - .1 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .2 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .3 ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .4 ASTM B308/B308M-20, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
  - .5 ASTM B429/B429M-20, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
  - .6 ASTM D1187/D1187M-97(2018), Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
  - .7 ASTM E488/E488M-22, Standard Test Methods for Strength of Anchors in Concrete Elements.
  - .8 ASTM F3125/F3125M-22, 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.
  - .9 ASTM F468-23, Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.

**1.4 DESIGN REQUIREMENTS**

- .1 Comply with specified Regulatory Requirements.
- .2 Sign supports to be capable of withstanding summation of following loads:
  - .1 Wind load in any direction of 0.32 kPa on signboards.
  - .2 Dead load of signboards, sign supports and appurtenances.
- .3 Structural deflections and vibration in accordance with American Association of State Highway and Transportation Officials (AASHTO), "Specifications for the Design and Construction of Structural Supports for Highway Signs".
- .4 Regulatory signs: shall be installed and removed only under acceptance of the Authority Having Jurisdiction.

## **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide required submissions in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit product data for each type of product specified.
- .3 Submit shop drawings indicating design, fabrication and installation details for signs and the following:
  - .1 Show sign mounting heights, locations of supplementary supports provided by other sections, and accessories.
  - .2 Provide message list, typestyles, graphic elements and layout for each sign.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Materials:
  - .1 ATS Traffic Group.
  - .2 Plas-Tech, Inc.
  - .3 Valley Traffic Systems.
  - .4 York Manufacturing Services.

### **2.2 METAL SIGNS**

- .1 Refer to Drawings site sign requirements and supply and install as required.
- .2 Flexible Posts:
  - .1 Flexible 57 mm diameter tubular, durable, non-colouring thermoplastic with 38 mm diameter reinforcement tube located and secured in the lower portion of the post.
  - .2 Hardware: integral with locking mechanisms.
  - .3 Colour: confirm with Consultant prior to ordering
  - .4 Acceptable Material:
    - .1 Safe-Hit, Safe-Hit Corporation, or equivalent.
- .3 Metal Sign Posts:
  - .1 Steel Supports for Small Signs: In accordance with ASTM B210M; tubular supports.
  - .2 Base Plates: Ground mounted signage base plates in accordance with ASTM B209M.
  - .3 Anchor and Connecting Bolts: 'U' clamps and miscellaneous hardware for overhead sign installations fabricated from Type 304 stainless steel in accordance with ASTM A276.
  - .4 Fasteners: Bolts, nuts, washers and other hardware for signs cast aluminum alloy or galvanized steel.
- .4 Signboards:
  - .1 Aluminum sheet: In accordance with ASTM B209M, pre-cut to required dimensions; 1.6 mm nominal thickness for signboards up to 750 mm wide; 2.1 mm nominal thickness for signboards 750 to 1200 mm wide.
  - .2 Connecting Straps and Brackets: In accordance with ASTM B209M.

- .3 Silk Screen Ink: Transparent or opaque colours: In accordance with standard traffic signage requirements of Authorities Having Jurisdiction; script content to meet traffic signage regulations of the Authorities Having Jurisdiction.
- .4 Reflective Sheeting and Tape: In accordance with CGSB 62 GP 11M; adhesive, class of reflectivity and colour to meet traffic signage regulations of the Authorities Having Jurisdiction.

## **2.3 FABRICATION**

- .1 Supports:
  - .1 Weld aluminum support members in accordance with CSA W47.2 with welds of same strength as adjacent member or casting.
  - .2 Remove sharp edges and burrs.
- .2 Signboards:
  - .1 Cut and shape signboard blanks to required shapes and dimensions.
  - .2 Spray signboard back and edges with prime coat and two finish coats in the same colour as the sign face.
  - .3 Spray face with prime coat and two finish coats of required colour for non reflective signboard faces.
  - .4 Cut and apply reflective background sheeting and lettering in accordance with manufacturer's instructions to match site signage requirements.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Supply and install traffic, warning and regulatory signage as indicated, and required by authorities having jurisdiction.
- .2 Erect supports to locations indicated on Drawings.
- .3 Erect posts plumb and square to the following installation tolerances:
  - .1 +50 mm from vertical for direct buried supports.
  - .2 +12 mm from vertical for signs erected on base plates and separate concrete footings; resting on levelling nuts and restrained with nuts and washers.
- .4 Coat underside of base plates with corrosion protective paint before installation.
- .5 Connect shoe base to shaft with inside and outside fillet welds.
- .6 Close open aluminum tubes and posts with aluminum cap; cut oblong holes in shoe bases to drain condensation; install aluminum bolt cover on each base plate restraining nut.
- .7 Steel Post Installation:
  - .1 Drive to required depth without damaging posts.
  - .2 Drill hole to required depth and set post in sand where rock or concrete is encountered.
  - .3 Backfill with concrete or grout in finished concrete surfaces.
- .8 Signboard Installation:
  - .1 Fasten signboards to supporting posts and brackets.
  - .2 Use T-shape aluminum stiffeners to join portions of sign panels on site; cover face of T-stiffener with material identical to face of sign panel.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.3 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.4 SCHEDULE**

- .1 Install as required to meet requirements of authorities having jurisdiction, and as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 06 40 00 – Architectural Woodwork..
- .3 Section 09 21 16 – Gypsum Board Assemblies.
- .4 Section 09 22 00 – Non-Structural Metal Framing.
- .5 Section 08 80 50 – Glazing.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .2 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip (Withdrawn 2014).
  - .3 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A666-23, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .5 ASTM A924/A924M-22a, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - .6 ASTM A1008/A1008M-21a, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
  - .7 ASTM B16/B16M-19, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
  - .8 ASTM B19-20, Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks.
  - .9 ASTM B456-17(2022), Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
  - .10 ASTM C1503-18, Standard Specification for Silvered Flat Glass Mirror.
- .2 CSA Group (CSA)
  - .1 CSA/ASC B651:23, Accessible Design for the Built Environment, Includes Errata (2023).
  - .2 CSA G164-18 (R2023), Hot Dip Galvanizing of Irregularly Shaped Articles, Includes Update No. 1 (2020).

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Construction Manager and Trade contractor's representative and Consultant in accordance with Section 01 31 19 –Project Meetings to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building trades.

- .4 Review manufacturer's installation instructions.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Indicate size and description of components, base material, surface finishes inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.
- .3 Submit samples in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Samples to be returned for inclusion into work.
- .4 Submit closeout data as follows:
  - .1 Provide maintenance data for toilet and bath accessories for incorporation into Operations and Maintenance Manual.
  - .2 Include list of sources for disposable supplies, replacement parts and service recommendations.

#### **1.5 EXTRA MATERIALS**

- .1 Provide special tools required for accessing, assembly/disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 – Closeout Submittals.
- .2 Deliver special tools to Consultant.

#### **1.6 QUALITY ASSURANCE**

- .1 Installer Qualifications: Installer shall have a minimum of five years' experience in installing products comparable to those specified in this section.

#### **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address. Ship in fully weather-protected packaging to keep insulation dry during transport.
- .3 Storage and Handling Requirements:
  - .1 Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Keep insulation dry and allow to thoroughly dry out before use if wet. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
  - .2 Protect plastic insulation as follows:
    - .1 Do not expose to sunlight, except to extent necessary for period of installation and concealment.
    - .2 Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
    - .3 Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

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**Part 2            Products**

**2.1            MATERIALS**

- .1      Sheet steel: to ASTM A653/A653M cold rolled, commercial quality, 0.912 mm minimum nominal thickness, with ZF001 designation zinc coating.
- .2      Stainless steel sheet metal: to ASTM A666, Type 304, finish as indicated in component list in 1.519 mm minimum nominal thickness.
- .3      Stainless steel tubing: Type 304, commercial grade, seamless welded, 1.2 mm wall thickness.
- .4      Fasteners: concealed screws and bolts hot dip galvanized after fabrication, tamper and theft resistant exposed fasteners to match material of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

**2.2            COMPONENTS**

- .1      Refer to Washroom Accessories Legend on the Drawings, and supply and install all products identified and listed.
- .2      Shelves: SAE type 304 stainless steel, non-directional satin finish, 18-gauge (1.2 mm), ¾ inch (19 mm) return edge; front edge hemmed. Brackets 16-gauge (1.6 mm).

**2.3            ACCESSORIES**

- .1      Supply all fasteners, anchors and accessories as required for complete installations. Coordinate blocking and in-wall support with other trades as required.

**2.4            FABRICATION**

- .1      Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2      Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3      Brake form sheet metal work with 1.5 mm radius bends.
- .4      Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5      Back paint components where contact is made with building finishes to prevent electrolysis.
- .6      Hot dip galvanize concealed ferrous metal anchors and fastening devices to CSA G164.
- .7      Shop assemble components and package complete with anchors and fittings.
- .8      Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9      Provide steel anchor plates and components for installation on studding and building framing.



## **2.5 FINISHES**

- .1 Chrome and nickel plating: to ASTM B456, satin finish.
- .2 Baked enamel: condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma, apply one coat Type 2 primer to CAN/CGSB-1.81 and bake, apply two coats Type 2 enamel to CAN/CGSB-1.88 and bake to hard, durable finish. Sand between final coats. Colour selected from standard range by Consultant.
- .3 Manufacturer's or brand names on face of units not acceptable.
- .4 Stainless Steel: No. 4 satin luster finish or bright polished finish as noted.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Verify wall thickness and construction that will accept recessed accessories.
- .2 Verify that solid blocking for support and anchoring of washroom accessories is installed where required. Confirm exact height and location with Consultant and Manufacturer's Instructions.
- .3 Verify that frames and anchors provided, whether by this Section or others, are correctly and securely installed ready to accept the accessory scheduled for the specific location.
- .4 Verify that painting is complete and dry in area of installation before accessories are installed.

### **3.2 INSTALLATION**

- .1 Coordinate and cooperate with other trades as required for in-wall blocking and structural support in accordance with shop drawings.
- .2 At gypsum wall board partitions, provide blocking for accessories as required. At grab bars, install solid shim between grab bar backplate and carrier mounting plate, thickness to suit gypsum wall board thickness and thickness of any applied finish. Securely anchor to supporting structure. Work shall comply with shop drawings.
- .3 Install and secure accessories rigidly in place as follows:
  - .1 Comply with shop drawings.
  - .2 Stud walls: install steel back-plate and other reinforcement as indicated per shop drawings to stud prior to gypsum board installation. Provide plate with threaded studs or plugs, or as otherwise indicated per shop drawings.
  - .3 Hollow masonry units or existing plaster/drywall: use toggle bolts drilled into cell/wall cavity, or as otherwise indicated per shop drawings.
  - .4 Solid masonry, marble, stone, or concrete: use bolt with lead expansion sleeve set into drilled hole, or as otherwise indicated per shop drawings.
  - .5 Toilet/shower compartments: use male/female through bolts, or as otherwise indicated per shop drawings.
- .4 Install grab bars on built-in anchors provided by bar manufacturer, or as otherwise indicated on shop drawings.
- .5 Use tamper-proof screws/bolts for fasteners.
- .6 Fill units with necessary supplies shortly before final acceptance of building.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.5 SCHEDULE**

- .1 Locate accessories where indicated, and to CSA / ASC B651. Exact locations to be confirmed by Consultant. Refer to Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Division 03: Cast-in-Place Concrete.
- .2 Section 04 22 00 – Unit Masonry.
- .3 Section 05 50 00 – Metal Fabrications.
- .4 Section 06 10 10 – Rough Carpentry.
- .5 Section 09 21 16 – Gypsum Board Assemblies.
- .6 Section 09 30 13 – Tiling.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A53/A53M-22, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A269/A269M-22, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .4 ASTM A276/A276M-23, Standard Specification for Stainless Steel Bars and Shapes.
  - .5 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .6 ASTM A312/A312M-22a, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .7 ASTM A325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength (Withdrawn 2016).
  - .8 ASTM A666-23, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .9 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .10 ASTM B188-15e1, Standard Specification for Seamless Copper Bus Pipe and Tube.
  - .11 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .12 ASTM B221M-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
  - .13 ASTM B308/B308M-20, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
  - .14 ASTM B429/B429M-20, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
  - .15 ASTM B632/B632M-18, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
  - .16 ASTM F468-23, Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.
  - .17 ASTM F593-22 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

- .2 Canadian General Standard Board (CGSB)
  - .1 CAN/CGSB-44.40-2001, Steel Clothing Locker.
- .3 CSA Group (CSA)
  - .1 CSA G40.20-13/G40.21-13 (R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CSA S16:19, Design of steel structures, Includes Errata (2019) and Errata (2023).
  - .3 CSA W47.1:19, Certification of companies for fusion welding of steel.
  - .4 CSA W48:23, Filler metals and allied materials for metal arc welding.
  - .5 CSA W55.3-08 (R2018), Certification of companies for resistance welding of steel and aluminum.
  - .6 CSA W59-18 (R2023), Welded Steel Construction, Includes Errata (2020).
  - .7 CSA W178.2-18 (R2023), Certification of Welding Inspectors.
- .4 National Association of Architectural Metal Manufacturers (NAAMM)
  - .1 NAAMM AMP 555-92, Code of Standard Practice for the Architectural Metal Industry.
  - .2 NAAMM MBG 531-17, Metal Bar Grating Manual.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Indicate the following:
    - .1 Type and class of locker.
    - .2 Thickness of metal.
    - .3 Fabricating and assembly methods.
    - .4 Assembled banks of lockers.
    - .5 Tops, hooks, shelves, bases, trim, numbers.
    - .6 Filler panels, end/back panels, doors, handles, locking method, ventilation method, finishes.
- .2 Submit samples in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit duplicate 50 x 50 mm samples of colour and finish on actual base metal.
- .3 Provide operation and maintenance data indicating adjustments, repair methods and replacement of locker doors and latching mechanisms for incorporation into manual specified in Section 01 78 00 – Contract Submittals.

### 1.4 QUALITY ASSURANCE

- .1 Installer to be an authorized representative of metal locker manufacturer for installation and maintenance of locker systems for this Project, with a minimum of five years' experience in installing products comparable to those specified in this section.
- .2 Sole source: all lockers shall be supplied by a single manufacturer.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Handle products in accordance with manufacturer's instructions; store in manufacturer's original packaging until ready for installation and protect from impacts and abrasion during storage.

**Part 2 Products**

**2.1 ACCEPTABLE MANUFACTURERS**

- .1 Canadian Locker Co., Ltd.
- .2 General Storage Systems.
- .3 Hadrian.
- .4 Lincora Group.
- .5 Shanahan's Limited Partnership

**2.2 MANUFACTURED UNITS**

- .1 Provide full height single tier medium-duty metal lockers: bolted to wall or freestanding back-to-back as identified.
- .2 Refer to and coordinate with the requirements on the Drawings.
- .3 Single-tier design; 450 mm wide, 1 830 mm high, 610 mm deep; ventilated; complete with metal sloping tops, end panels, fillers and jamb trims; mounted on raised plywood platform.
- .4 Double-tier design; 305 mm wide, 1 830 mm high, 610 mm deep; ventilated; complete with metal sloping tops, end panels, fillers and jamb trims; mounted on raised platform.
- .5 Where lockers are not recessed into walls or do not have a bulkhead above them, sloped locker tops are required.

**2.3 MATERIALS FOR METAL LOCKERS**

- .1 Metal locker parts to be made of mild cold rolled sheet steel free from surface imperfections and contaminants.
- .2 Assembly fasteners to be zinc plated flat head screws with hex nuts.
- .3 Base: Provide 100 mm plywood base platform on raised framing to all lockers. Clad with tile base as indicated on Drawings, and as per the requirements of Section 09 30 13 - Tiling.

**2.4 PERFORMANCE REQUIREMENTS**

- .1 Frame: 16 ga. formed steel channel welded to form to form a one-piece construction with an integral continuous door stop on both hasp and hinge sides.
- .2 Bodies:
  - .1 Fabricated from minimum 24 ga. cold rolled steel. Back and sides will be provided with continuous lock forming, running the complete height of the locker.
  - .2 Door frame will be minimum 1.4 mm formed steel channel, welded for a one piece construction, complete with heavy duty padlock hasp.
- .3 Hinges: three 14 ga. (1.8 mm) 5 knuckle hinges for each door, featuring a non-removable pin. The hinges are welded to the frame.
- .4 Doors:
  - .1 Outer panel 20 ga. cold rolled steel, inner panel 24 ga. cold rolled steel. Sandwich panel construction fully welded with venting perforations throughout. Door complete with recessed handle box to accept locking device and two rubber bumpers.

- .5 Include stainless steel, flush inset handle box, and black plastic number plates with white numbers inset in finger pull. Numbering plan will be approved by the Owner.
- .6 Number Plates for Metal Lockers:
  - .1 Each door to have a high-strength black laminated plastic number plate with silver embossed numbers and/or letters..
  - .2 Plates to accommodate up to four digits, be nestled in a recess flush with door surface and to be fastened to door with two rivets. Unless otherwise directed by Owner, lockers to be numbered consecutively from 1 - up.

## **2.5 ACCESSORIES**

- .1 Provide 1 shelf and 3 heavy-duty, chrome plated clothes hooks in each single-tier full height lockers.
- .2 Provide 1 horizontal coat rod mounted below the top shelf.
- .3 Provide 2 - single prong hooks mounted to exterior of locker doors.
- .4 Equip lockers with 3.1 mm thick cold rolled steel padlock hasp with magnetic catch.
- .5 Provide lockers with integral punch-number locks.
- .6 Provide metal trim, and finished end panels except where recessed into walls or finished with millwork end panels.
- .7 Continuous metal base, finished end panels, filler panels and slope top are manufactured from 20 gauge cold-rolled steel. Trim to match locker frame.
- .8 Provide rubber door bumpers.

## **2.6 FINISHES FOR METAL LOCKERS**

- .1 All exposed metal shall be machine cleaned, phosphatized, and finished with 2 coats of a high-performance epoxy powder coating, baked on to provide a uniform, smooth, protective finish.
- .2 Colour: as selected by Consultant from manufacturer's standard range.
- .3 Locker frame colour: as selected by Consultant from manufacturer's standard range.
- .4 All interior body parts colour: as selected by Consultant from manufacturer's standard range.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 INSTALLATION**

- .1 Confirm locations with Consultant prior to ordering materials and installation.
- .2 Assemble and install lockers on base provided by others in accordance with manufacturer's printed installation instructions and details.
- .3 Securely fasten lockers to grounds and support frames. Minimum pullout force: 445 N (100 lb.). Attachment of back to walls to allow 25 mm ventilation space.
- .4 Bolt adjoining locker units together to provide rigid installation.
- .5 Banks of lockers shall be fabricated and installed to achieve one continuous top, full length, no joints.
- .6 Install wall trim around recessed locker banks.
- .7 Install filler panels (false fronts) where indicated and where obstructions occur.
- .8 Install accessories.
- .9 Installation to allow for ventilation at bottom and back as shown in details.
- .10 Replace components that do not operate smoothly.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.5 SCHEDULE**

- .1 Supply and install as indicated on Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 cast-in-place concrete.

**1.2 REFERENCES**

- .1 The Aluminum Association (AA):
  - .1 AA DAF-45-2003 9R2009), Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturer's Association (AAMA):
  - .1 AAMA 611-20, Voluntary Specification for Anodized Architectural Aluminum.
- .3 ASTM International (ASTM):
  - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .3 ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
  - .4 ASTM B221M-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
  - .5 ASTM C33/C33M-18, Standard Specification for Concrete Aggregates.
  - .6 ASTM C1107/C1107M-20, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - .7 ASTM F593-24, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - .8 ASTM F594-24, Standard Specification for Stainless Steel Nuts.
- .4 CSA Group (CSA):
  - .1 CSA-B72:20, Installation code for lightning protection systems.
  - .2 CSA W59.2-18, Welded aluminum construction.
- .5 National Association of Architectural Metal Manufacturers (NAAMM):
  - .1 ANSI/AMP-FP 1001-07, Guide Specifications for Design of Metal Flagpoles Manual.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate installation of anchorages for flagpoles. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals shall meet the requirements of Section 01 33 00 – Submittal Procedures.
- .2 Submit product data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheets.



- .3 Submit Engineered Shop Drawings:
  - .1 Indicate dimensions, finishes, base jointing, anchoring and support systems, cleats, halyard boxes, trucks, finials and base collar for flagpoles.
  - .2 Submit setting drawings, templates, and directions for installing anchor bolts and other anchorages.
  - .3 Include a section and details of foundation system for ground-mounted flagpoles.
  - .4 Shop Drawings shall be designed, sealed and signed by a delegated design engineer (P.Eng.) licenced to practice in Ontario, including foundations, pole assembly, erection and other details as required.
- .4 Submit samples:
  - .1 Submit samples for each finished material used for flagpoles and accessories for verification of selections by the Consultant.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer's technical data and installation instructions for each type of flagpole.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data:
  - .1 Include, in the operation and maintenance manual, manufacturer's maintenance and operating instructions, and recommended cleaning materials and methods for flagpoles.

## **1.6 MAINTENANCE MATERIALS SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Tools:
  - .1 Supply two keys per flagpole for internal halyard access door cylinder lock.

## **1.1 QUALITY ASSURANCE**

- .1 Provide each flagpole as complete unit produced by single manufacturer, including fittings, accessories, bases and anchorage devices.
- .2 Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.
- .3 Construct pole and ship to site in one piece if possible. If more than one piece is necessary, provide snug-fitting precision joints with self-aligning, internal splicing sleeve arrangement for weather-tight, hairline field joints.

## **1.2 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's instructions.
  - .1 Delivery and Acceptance Requirements:
    - .1 Spiral wrap each flagpole with heavy kraft paper, wood strip and steel band, or polyethylene wrap, and pack in tubing for shipment.
    - .2 Deliver aluminum flagpoles protected from moisture.
    - .3 Deliver each flagpole in one piece.

- .4 After delivery, remove wet wrapping materials and dry surfaces promptly.
- .5 Store aluminum components in a dry area with adequate ventilation.  
Remove condensation and other sources of water promptly.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
  - .1 Ewing Flagpole Co. Inc.
    - .1 Flagpole: Cone Tapered Aluminum.
    - .2 Base: Type B-5 Fixed.
    - .3 Halyard: Internal System.
  - .2 Flag Outlet Ltd.
    - .1 Flagpole: Cone Tapered Flagpole.
    - .2 Base: Stationary Base.
    - .3 Halyard: Internal System.
  - .3 Approved Alternates.

### **2.2 PERFORMANCE/DESIGN CRITERIA**

- .1 Provide flagpole assemblies including; but not limited to, anchorages and supports capable of withstanding effects of wind loads determined in accordance with 1:50 year wind load criteria listed in the applicable Building Code specific for the municipality of installation.
  - .1 Design for 910 mm x 1830 mm flag size.
- .2 Description:
  - .1 Type: Aluminum, with an internal halyard, rotating ball, tilt base, and with clear anodized finish.
  - .2 Exposed Height: 7600 mm (25-feet).
  - .3 Butt Diameter: 5-inches.
  - .4 Top Diameter: 4-inches.

### **2.3 MATERIALS**

- .1 Aluminum: To AA alloy 6063-T5 or 6063-T6.
  - .1 Fabricate from seamless extruded tubing in accordance with ASTM B221 or ASTM B221M, heat treated and age hardened after fabrication.
    - .1 Tensile strength: 200 MPa (30,000 psi) minimum.
    - .2 Yield point: 170 MPa (25,000 psi) minimum.
- .2 Isolation coating: alkali-resistant bituminous paint or epoxy resin solution.
- .3 Bolts, nuts, washers: ASTM F593 and ASTM F594, stainless steel.
- .4 Mounting Type:

- .1 Ground Sleeve: 16-gauge steel foundation sleeve, hot dipped galvanized after fabrication to ASTM A123/A123M, with steel base plate securely welded, made to fit flagpole, for casting into concrete foundation:
  - .1 Provide flashing collar of same material and finish as flagpole.
  - .2 Butt diameter: 6-inches.
  - .3 Sleeve diameter: 8-inches.

## 2.4 FABRICATION

- .1 Supply flagpole as complete unit including base, mounting brackets, anchorage and fittings.
- .2 Cone tapered flagpole:
  - .1 Seamless, uniform, straight line tapered section above cylindrical butt section.
  - .2 Taper: manufacturer's standard.
  - .3 Provide internal splicing, self-aligning sleeve of same material as flagpole for snug fitting, watertight field joints.
- .3 Fabricate ground-set foundation assembly for sleeve installation of flagpole.
- .4 Fabricate mountings of same metal as flagpoles where exposed and of galvanized steel below ground level or where encased in concrete.
- .5 Shop-apply isolation coating to metal surfaces of flagpole and base that will be encased in concrete or below grade level.
- .6 Perform welding to CSA W59.2, by welders certified by Canadian Welding Bureau. Finish exposed welds flush and smooth.

## 2.5 ACCESSORIES

- .1 Finial: Manufacturer's standard flush seam ball, size to match flagpole diameter, fabricated from nominal 1.6 mm thickness spun aluminum, finished to match flagpole with gold anodic finish.
- .2 Truck assembly: cast aluminum, stainless steel ball-bearings, non-fouling, revolving double truck assembly, finish to match flagpole.
- .3 Halyard:
  - .1 Internal halyard, cam cleat system: aircraft grade stainless steel cable halyard, cam cleat, and concealed revolving truck assembly with plastic coated counterweight and sling.
    - .1 Provide flush access door secured with cylinder lock.
- .4 Halyard Flag Snaps: Provide two chrome plated bronze swivel snap hooks per halyard with neoprene or vinyl covers or manufacturer's standard injection moulded plastic halyard flag clips.
- .5 Provide flashing collar of same material and finish as flagpole.
- .6 Concrete: Normal weight, 5 - 7% air entrained, ready-mix concrete having minimum 28-day compressive strength of 35 MPa, in accordance with Section 03 30 00.
- .7 Sand: ASTM C33, fine aggregate.
- .8 Elastomeric Joint Sealant: Multi-component urethane joint sealant in accordance with Section 07 92 00.
- .9 Flag: supplied by Owner.

- .10 Lightning Ground Rod: 60 inches (1525 mm) long, copper rod,  $\frac{3}{4}$ " (19 mm) diameter.
- .11 Lightning Ground Cable: Copper No. 6 AWG, soft-drawn.

## **2.6 FINISHES**

- .1 Finish flagpoles in accordance with NAAMM recommendations for applying and designating finishes.
- .2 Aluminum:
  - .1 Finish exposed surfaces of aluminum components in accordance with AA DAF-45.
  - .2 Aluminum coatings: To Aluminum Association Architectural Class I.
  - .3 Clear anodic finish, AA M32-C22-A41.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.2 EXAMINATION**

- .1 Examine site conditions where Work will be applied and ensure acceptability for complete and satisfactory installation; beginning of installation will denote acceptance of site conditions.

### **3.3 PREPARATION**

- .1 Prepare uncoated metal flagpoles that are set in foundation tubes by painting below grade portions with a heavy coat of bituminous paint.
- .2 Excavate foundations to neat clean lines in undisturbed soil; remove loose soil and foreign matter from excavation and moisten earth before placing concrete.
- .3 Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade; secure and brace forms and foundation tube, sleeve, or anchor bolts in position, to prevent displacement during concreting.
- .4 Place concrete immediately after mixing; compact concrete in place by using vibrators; moist cure exposed concrete for not less than seven days or use non-staining curing compound.
- .5 Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance; provide positive slope for water runoff to perimeter of concrete base.

### **3.4 INSTALLATION**

- .1 Install flagpoles, base assemblies, and fittings to shop drawings and manufacturer's instructions. Provide positive lightning ground for each flagpole installation.
- .2 Provide concrete base and piling in accordance with Section 03 30 00.
- .3 Finish exposed concrete surfaces flush with adjacent concrete slab-on-grade. Provide light sandblast finish.
- .4 Install flagpoles plumb.
- .5 Provide ground stakes to depth as required for positive lightning ground for each ground set flagpole installation.
  - .1 Install interconnecting conductors, ground electrodes, a down conductor system, and other components for a complete lightning protection system to CSA B72.
  - .2 Coordinate with Electrical Drawings and Specifications for grounding.

### **3.5 ERECTION TOLERANCES**

- .1 Maximum Variation from Plumb: 25 mm.

### **3.6 ADJUSTING**

- .1 Check and adjust installed fittings for smooth operation of halyards.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with the requirements of Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.
- .3 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

### **3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.9 CLOSEOUT ACTIVITIES**

- .1 Training:
  - .1 Train Owner's personnel in accordance with Section 01 79 00 – Demonstration and Training.
  - .2 Instruct personnel in safety precautions, and operation of halyards and troubleshooting.

### **3.10 SCHEDULE**

- .1 Install as indicated on Drawings.

**END OF SECTION**

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**Part 1            General**

**1.1                REQUEST FOR QUOTATIONS**

- .1      This Section sets out the general requirements for pre-engineered building 'Supplier' to submit design-build turnkey proposals to all general contractors bidding the project to design, supply, fabricate, and install a custom pre-engineered building, including building enclosure claddings and structure (roof and walls), and all other items required for a complete pre-engineered building turnkey installation as indicated on the design Drawings.
- .2      Proposal price must include for all design, labour, supervision, coordination, freight, shipping, handling, storage, progress and final cleaning, related construction waste removal, materials, products, safety training and ongoing safety measures, overhead, profit and all other costs involved in the design, supply, fabrication, and installation of a turnkey pre-engineered building as indicated on the design Drawings and as per the requirements of this Section.
- .3      The successful design-build 'Supplier' shall cooperate fully and coordinate with the Contractor and all related trades as required, including safety training, access and other requirements.
- .4      Coordinate with landscape, civil, structural, mechanical and electrical Drawings and Specifications for related requirements and interface information. Cooperate with the respective trades as required to maintain the construction schedule and adhere to a logical sequence of installation.
- .5      The proposal submitted by the design-build 'Supplier' shall include at minimum the following:
  - .1      a firm price to design, supply, fabricate, ship, handle, unload, provide related waste disposal and progress and final cleaning, and erect and install a complete turnkey custom pre-engineered building,
  - .2      schedule, including delivery, fabrication and installation timelines and dates,
  - .3      a complete description of the offered services,
  - .4      a list of all materials, products, parts and components to be supplied and installed,
  - .5      a list of all items to be supplied by others but installed by 'Supplier',
  - .6      make and model information for premanufactured components,
  - .7      technical datasheets,
  - .8      specifications,
  - .9      list any spare parts/components that will be provided,
  - .10     description of training offered and time involved in training,
  - .11     list of any exclusions that other trades or the General Contractor will need to provide that will be necessary for a complete pre-engineered building installation,
  - .12     maintenance and operating instructions,
  - .13     all warranties,

- .14 and other information that the design-build 'Supplier' considers important in facilitating consideration of their proposal.

## **1.2 SUMMARY OF SCOPE FOR PRE-ENGINEERED 'SUPPLIER'**

- .1 Provide pre-engineered building as per Drawings and Specifications.
- .2 The following summary does not replace or remove any scope of work requirements noted on Drawings and is provided as a high-level summary for convenience. The 'Supplier' must read and consider all the Bid Documents as a whole in determining requirements.
- .3 The 'Supplier' must coordinate and cooperate with the General Contractor as required to ensure the continuity of the water, thermal, air and vapour control systems of the enclosure.
- .4 The 'Supplier' must coordinate and cooperate with the General Contractor as required to ensure that the total Work of project is executed as per Drawings and Specifications.
- .5 Standard materials furnished for the pre-engineered building system will include primary and secondary structural steel framing members, bracing, steel panels for roofing, siding, and interior liner, flashings, fasteners, sealants, accessories and all other miscellaneous component parts required for a complete building as follows:
  - .1 Exterior wall W-EX1:
    - .1 Z-girts for cladding attachment between cladding and Z-girt sub-structure, and Z-girt sub-structure attached to structural steel framing, as indicated and as required,
    - .2 Preformed metal cladding, to Section 07 46 19 – Preformed Metal Cladding.
    - .3 Corner trims and window and door trims; cooperate and coordinate with window and door trades as required to properly sequence the work and ensure continuity of air, vapour and thermal control layers.
    - .4 Rigid and fibrous insulation as required, and as shown on Drawings; insulation to be supplied by other trades to be installed by pre-engineered 'Supplier'.
  - .2 Steel Liner Panels:
    - .1 Steel liner panels (interior finish), including supply, installation, sealing and caulking. The steel liner panes are at the roof and walls in the fire bay and mezzanine. Within the office area, the steel liner is applied on the walls only above the office ceiling level. This is on Drawings.
  - .3 R-1 roof assembly:
    - .1 Entire roof assembly, to Section 07 61 13 – Standing Seam Sheet Metal Roofing; insulation to meet or exceed the R-values indicated on Drawings.

- .2 All roofing accessories as required, including but not necessarily limited to the following:
  - .1 thermal attachment clips,
  - .2 thermal blocks,
  - .3 eaves/gutters,
  - .4 downspouts,
  - .5 flashings, trims, caulking,
  - .6 other accessories as required for a complete roofing installation.
- .4 R-2 roof assembly (canopy):
  - .1 Steel structure and metal decking.
- .5 R-3 roof assembly (canopy):
  - .1 Steel structure and metal decking.
- .6 F-3 floor assembly (mezzanine):
  - .1 Open web joists (OWSJ) and metal decking,
  - .2 Interior columns supporting the mezzanine.
- .7 The building's entire steel structure, including, but not necessarily limited to, the following:
  - .1 Exterior columns and roof rafters forming the building's main framing,
  - .2 Interior columns, open web steel joists (OWSJ) and metal decking for the mezzanine (mezzanine concrete topping by general contractor),
  - .3 Exterior Z-girts and exterior roof purlins,
  - .4 Steel rod bracing as required.
- .8 Insulation: Supply and installation of insulation (all types) shall be as determined by the General Contractor in consultation with the pre-engineered building Supplier. R-values noted on Drawings must be met or exceeded.
- .9 Exclusions:
  - .1 Concrete work: foundations, floor slabs, mezzanine topping, anchor bolts and other embedded items,
  - .2 Wall type W-EX2 ('Supplier' shall ensure proper connection to structure and continuity of thermal, vapour and air control layers),
  - .3 Aluminum composite panels, supply and install,
  - .4 Windows, doors and overhead doors, and hardware
  - .5 Canopy claddings and roofing,
  - .6 Interior partitions,
  - .7 W-P2b assembly,
  - .8 Concrete unit masonry,
  - .9 Exterior work beyond the building footprint,
  - .10 Interior finishes,



- .11 Furniture, fixtures and equipment,
- .12 Electrical, mechanical, landscape and civil work.
- .13 Other parts of the Work not allocated to Supplier but required for a complete installation.

### **1.3 RELATED REQUIREMENTS**

- .1 Division 03 cast-in-place concrete.
- .2 Division 05 structural steel.
- .3 Section 03 53 00 – Concrete Topping.
- .4 Section 04 22 00 – Unit Masonry.
- .5 Section 05 41 00 – Structural Metal Stud Framing.
- .6 Section 05 50 00 – Metal Fabrications.
- .7 Section 05 51 00 – Metal Stairs and Railings.
- .8 Section 06 10 00 – Rough Carpentry.
- .9 Section 07 21 13 – Board Insulation.
- .10 Section 07 21 16 – Fibrous Insulation.
- .11 Section 07 21 29 – Spray Applied Polyurethane Foam.
- .12 Section 07 26 13 – Polyethylene Vapour Control System.
- .13 Section 07 42 42 – Aluminum Composite Panels.
- .14 Section 07 46 19 – Preformed Metal Cladding.
- .15 Section 07 61 13 – Standing Seam Sheet Metal Roofing.
- .16 Section 07 62 00 – Sheet Metal Flashing and Trim.
- .17 Section 07 92 00 – Joint Sealants.
- .18 Section 08 11 14 – Metal Doors and Frames.
- .19 Section 08 36 40 – Glazed Overhead Doors.
- .20 Section 08 44 13 – Glazed Aluminum Framing Systems.
- .21 Section 08 71 00 – Door Hardware.
- .22 Section 08 80 50 – Glazing.
- .23 Section 09 91 00 – Painting.
- .24 Other Sections and Divisions requiring accommodation and interface as required, and as noted on Drawings and Specifications.
- .25 Drawings.

## 1.4 REFERENCES

- .1 ASTM International (ASTM)
  - .1 ASTM A36/A36M-19, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .4 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  - .5 ASTM A500/A500M-23, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - .6 ASTM A529/A529M-19, Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
  - .7 ASTM A572/A572M-21e1, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
  - .8 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .9 ASTM A755/A755M-18(2024), Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
  - .10 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .11 ASTM A792/A792M-23, Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .12 ASTM A992/A992M-22, Standard Specification for Structural Steel Shapes.
  - .13 ASTM A1011/A1011M-23, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
  - .14 ASTM C1107/C1107M-20, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - .15 ASTM D659-86e1, Method of Evaluating Degree of Chalking of Exterior Paints.
  - .16 ASTM D2244-23, Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
  - .17 ASTM E283/E283M-19, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - .18 ASTM E331-00(2023), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

- .19 ASTM E1646-95(2024), Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
- .20 ASTM E1680-16(2022), Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
- .21 ASTM E3158-24, Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building.
- .22 ASTM F1554-20, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- .23 ASTM F3125/F3125M-23, 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
- .2 Canadian Institute of Steel Construction (CISC ):
  - .1 CISC/CPMA Standard 1-73a (1975), A Quick Drying One Coat Primer for Use on Structural Steel.
- .3 Canadian Sheet Steel Buildings Institute (CSSBI):
  - .1 CSSBI B8-15, Buildings Incorporating Steel Building Systems: Responsibilities of the Parties Involved.
  - .2 CSSBI C1-17, Certificate of Design and Manufacturing Conformance with NBC 2015.
  - .3 CSSBI S8-18, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
  - .4 CSSBI S10-15, Insulated Sheet Steel Wall Assemblies.
  - .5 CSSBI S11-15, Insulated Sheet Steel Roof Assemblies.
  - .6 CSSBI 30M-17, Standard for Steel Building Systems.
- .4 CSA Group (CSA):
  - .1 CSA A660-10 (R2024), Certification of Manufacturers of Steel Building Systems, Includes Update No. 1 (2010).
  - .2 CAN/CSA G12-14 (R2019), Zinc-Coated Steel Wire Strand.
  - .3 CSA G40.20-13/G40.21-13 (R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .4 CSA S16:24, Design and construction of steel structures.
  - .5 CSA S136-16 (R2021), North American Specification for the Design of Cold Formed Steel Structural Members
  - .6 CSA W47.1:19 (R2024), Certification of companies for fusion welding of steel.
  - .7 CSA W55.3-08 (R2023), Certification of companies for resistance welding of steel and aluminum.
  - .8 CSA W59:24, Welded Steel Construction.

- .5 Canadian Sheet Steel Building Institute (CSSBI)
  - .1 CSSBI B8-2015: Buildings Incorporating Steel Building Systems: Responsibilities
  - .2 of the Parties Involved.
  - .3 CSSBI B20-15: Thermal Transmittance of Insulated Sheet Steel Wall and Roof Assemblies.
  - .4 CSSBI 20M-17: Standard for Sheet Steel Cladding for Industrial, Commercial and Institutional Building Applications.
  - .5 CSSBI SSF 42-15: Fastening Prepainted Sheet Steel Roofing and Siding.
  - .6 CSSBI SSF 44-16: Thermal Transmittance of Insulated Metal Building Wall and Roof Assemblies.
- .6 Metal Building Manufacturers Association (MBMA)
  - .1 MBMA Metal Building Systems Manual, 2024 Edition.
- .7 Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International): Coating Materials Guidelines Surface Preparation Guidelines:
  - .1 SSPC SP2-2024, Hand Tool Cleaning.
  - .2 SSPC SP3-2024, Power Tool Cleaning.
  - .3 SSPC SP6/NACE No. 3, Joint Surface Preparation Standard: Commercial Blast Cleaning, 09/13/2006.
- .8 ULC Standards (ULC):
  - .1 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2 ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 ULC S702.1-21, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .4 ULC S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
  - .5 CAN/ULC S741-08, Standard for Air Barrier Materials – Specification.
  - .6 CAN/ULC S742-20, Standard for Air Barrier Assemblies – Specification.

## 1.5 DEFINITIONS

- .1 Cladding: Exposed exterior wall and roof skin of any material type and combination including fasteners and attachments, weather sealants, trim, flashing, fascia, and closures, as applicable.
- .2 Steel Building System: Integrated assembly of manufactured steel structural components and cladding components specifically designed by the 'Supplier' to support and transfer loads and provide a complete or partial building shell.

- .3 Structural Framing: Steel framework consisting of primary members (rigid frames, beams, girders, trusses, arches, rafters, columns), secondary members (purlins, joists, struts, bracing, tension rods, girts, eave struts, base angle and channel, header, jambs, sills and other structural items) and all necessary hardware.
- .4 'Supplier': when referencing the 'Supplier' of the pre-engineered steel building, 'Supplier' shall mean the steel building manufacturer/installer as defined by CAN/CSA A660, responsible for the design, manufacturing, supply and installation of a complete turn-key metal building.

## **1.6 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination:
  - .1 Coordinate and cooperate with other trades as required for a complete, weathertight installation, with continuity of insulation and air and vapour control systems and materials maintained.
  - .2 Coordinate and cooperate with other trades as required to ensure maintenance of the construction schedule, and the proper interface with and integration of their scopes of work with the work of this Section.
  - .3 Sequencing: Coordinate installation with work upon which the work of this Section depends.
  - .4 Provide items to be integrated or built into other work to appropriate trade in timely manner in accordance with construction schedule. Provide templates and shop drawings indicating layout, locations and details as required for proper placement of cast-in or built-in items.
- .2 Pre-Construction Meeting: Arrange a pre-construction meeting in accordance with Section 01 31 19 - Project Meetings to review methods and procedures related to steel building systems, and as follows:
  - .1 Review and discuss condition of foundations and other work of other trades.
  - .2 Review structural load limitations.
  - .3 Review and finalize construction schedule and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
  - .4 Review required testing, inspecting, and certifying procedures.
  - .5 Review procedures for unfavourable conditions.
  - .6 Review installation instructions and guidelines, and warranty requirements.

## **1.7 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide requested submissions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets, installation instructions and standard details for each product and system to be incorporated into the work.

- .3 Submit engineered, sealed and signed Shop Drawings for the steel building assembly, including plans, elevations, sections, details, attachments to other work and to structure, and the following:
  - .1 Structural analysis data signed and sealed by the qualified professional engineer (P.Eng.) responsible for their preparation for products required to meet design loads, and licensed to practice in the Province of Ontario; coordinate and cooperate with the Consultant design team as required.
  - .2 Include requirements for foundations.
  - .3 Anchor bolt plans before foundation work begins, including location, diameter, and projection of anchor bolts required to attach metal building to foundation; indicate column reactions at each location.
  - .4 The Shop Drawings shall include and detail interface and connections to adjacent construction.
  - .5 Shop Drawings shall include the pre-engineered building structure, and the complete enclosure, including but not limited to structure, Z-girts, wall cladding, roof cladding, and thermal, vapour and air control layers and systems. Include insulation supplied by other but installed by 'Supplier'.
  - .6 Design reinforcement, anchors and supports as required by OBC, Submit relevant design data prepared by a qualified structural engineer (P.Eng.) for review.
  - .7 Fabrication of primary and secondary framing including provisions for openings; indicate welded and bolted connections, distinguishing between shop and site applications; and transverse cross sections.
  - .8 Design for post-disaster importance factors as per OBC, and relevant OBC commentaries. Refer to structural design Drawings, PROJECT DESIGN DATA TABLE, for load data.
  - .9 Submit Letter of Commitment and Letter of Compliance in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .4 Submit samples of each type of exposed finish required for verification by the Consultant as follows:
  - .1 Metal Roof and Wall Panels: 300 mm square, including fasteners, closures, and other exposed panel accessories.
  - .2 Flashing and Trim: 300 mm square, including fasteners and other exposed accessories.
  - .3 Vapour Retarders: 150 mm square.
  - .4 Accessories: 300 mm long samples for each type of accessory.
- .5 Submit warranties as specified.

## **1.8 PROJECT CLOSEOUT SUBMISSIONS**

- .1 Provide operations and maintenance information in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit completed CSSBI C1 document signed and sealed by a professional engineer indicating compliance with specified and regulated requirements for steel building systems.
- .3 Submit maintenance data, special warranties for finishes for inclusion in operations and maintenance manuals.

## **1.9 QUALITY ASSURANCE**

- .1 The fire station is classified under the OBC as having a post-disaster importance factor, and must be designed to remain functional and accessible after a disaster in accordance with the OBC.
- .2 Use an experienced steel building erector having experience in erecting and installing similar work and who is acceptable to steel building 'Supplier', certified to perform site welding, to CSA W47.1.
- .3 Obtain the steel building structure and assembly from a single 'Supplier' (manufacturer) meeting the following minimum requirements:
  - .1 Minimum 10 years experience designing and erecting pre-engineered metal buildings.
  - .2 Certified in accordance with CSA A660.
  - .3 Member of the Canadian Sheet Steel Building Institute (CSSBI).
  - .4 Certified by the Canadian Welding Bureau, to CSA W47.1, and specializes in the design and fabrication of steel building systems.
  - .5 Has the responsibility to prepare engineered shop drawings and perform comprehensive engineering analysis of the required building systems using a qualified professional engineer.
- .4 Obtain primary steel building system components, including structural framing and metal panel assemblies, through one source from a single 'Supplier'.
- .5 Perform welding, to CSA W59.
- .6 Provide structural steel, to CAN/CSA S16.
- .7 Provide cold formed steel, to CAN/CSA S136.
- .8 Meet requirements of the applicable Building Code.

## **1.10 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver components, sheets, panels, and other manufactured items to prevent damage or deformation; package metal panels for protection during transportation and handling.
- .2 Unload, store, and erect metal panels to prevent bending, warping, twisting, and surface damage.

- .3 Stack metal panels horizontally on platforms or pallets, covered with suitable weather tight and ventilated covering and as follows:
  - .1 Store metal panels to ensure dryness and with positive slope for drainage of water.
  - .2 Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

#### **1.11 PROJECT CONDITIONS**

- .1 Proceed with installation only when weather conditions permit metal panels to be installed in accordance with 'Supplier's' written instructions and warranty requirements.
- .2 Site Measurements:
  - .1 Established Dimensions for Foundations:
    - .1 Proceed with fabricating structural framing without site measurements based on established dimensions of anchor bolt locations and foundation dimensions provided by the Construction Manager.
    - .2 Coordinate anchor bolt placement to ensure that actual anchorage dimensions correspond to established dimensions.
  - .2 Established Dimensions for Metal Panels:
    - .1 Establish framing and opening dimensions and proceed with fabricating metal panels without site measurements, or allow for site trimming metal panels where site measurements cannot be made without delaying the Work, at choice of 'Supplier' after consultation with Construction Manager and Consultant.
    - .2 Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

#### **1.12 WARRANTIES**

- .1 Steelway Building Systems' Warranty Program shall be considered the minimum standard of acceptance for warranty terms and conditions. Other Suppliers must provide warranties of same or better terms and conditions, as determined by the Owner at its sole discretion.
  - .1 Submit Supplier's standard materials and workmanship warranty.
  - .2 Submit Supplier's standard warranty for Silicone Modified Polyester Series Prepainted Roof & Wall Panels.
  - .3 Submit Supplier's standard warranty for Galvalume Product AZ 165 Coating.
  - .4 Submit Supplier's optional 20-year weather-tightness warranty.



**Part 2 Products**

**2.1 SYSTEM DESCRIPTION**

- .1 Provide a complete, integrated set of pre-engineered building mutually-dependent components and assemblies that form a complete steel building system capable of withstanding noted structural and other loads, thermally induced movement, and exposure to weather, without failure or infiltration of water into building interior. Air and water infiltration rates at the exterior enclosure not to exceed specified limits.
- .2 Standard materials furnished for the steel building system will include primary and secondary structural steel framing members, bracing, steel panels for roofing and siding, interior steel liner panels, flashings, fasteners, sealants, accessories and all other miscellaneous component parts required for a complete building (with the exception of insulation, doors, windows, hardware, foundations, anchor bolts and other embedded items, which are excluded).
- .3 Coordinate and cooperate with other trades as required.

**2.2 DESIGN AND PERFORMANCE REQUIREMENTS**

- .1 The pre-engineered building 'Supplier' is responsible to meet the following requirements:
  - .1 Design Requirements:
    - .1 Provide steel building systems capable of withstanding loads and stresses in accordance with the MBMA Metal Building Systems Manual, CSSBI 30M, CAN/CSA S16, CAN/CSA S136, and other governing standards.
    - .2 The fire station is classified under the OBC as having a post-disaster importance factor, and must be designed to remain safe, functional and accessible after a disaster in accordance with the OBC.
    - .3 The site qualifies as a Site Class D according to the geotechnical report and the structural design Drawings.
      - .1 Parts of the Work which might become dislodged or damaged during an earthquake and compromise the safety, accessibility or useability of the building in a post-disaster circumstance must have attachments to structure and seismic bracing and anchorage designed by a delegated design professional engineer (P.Eng.) licensed to practice in Ontario.
    - .4 Design members to accommodate deflection limitations in accordance with the Ontario Building Code and published amendments (OBC).
    - .5 Design pre-engineered building to carry vertical and horizontal post-disaster loads noted on structural design Drawings in accordance with OBC. Design shall include resistance to foundation creep and shrinkage, and temperature effects generally, as well as wind and earthquake loads.

- .6 Design structure and connections to take diaphragm forces for post-disaster lateral loading; design loads are noted on the structural design Drawings. Assemblies, connections and sealant joints must be designed to accommodate expected in-plane and out-of-plane movement as noted on structural design Drawings.
- .7 Hold-down connections to be provided with dimensions to formwork contractor to place prior to pouring foundations. Pre-engineered building 'Supplier' to validate that these connections are in place prior to pouring concrete walls.
- .8 Design members to account for the following criteria:
  - .1 Vertical loads induced by building occupancy, including loads induced by maintenance workers, materials, and equipment for roof live loads.
  - .2 Collateral loads induced by additional dead loads other than the weight of steel building system for permanent items such as sprinklers, mechanical systems, electrical systems, and ceilings.
  - .3 Load combinations arising from critical effects of load factors and load combinations.
  - .4 Maximum deflection of  $L/240$  of clear span for roofing under full live loads.
  - .5 Maximum deflection of  $L/180$  of clear span for exterior wall cladding under full exterior wind induced loads
- .9 Maintain tolerances for building structure and enclosure elements as noted on the structural design Drawings and as required for the various components of the building to properly fit together and perform as specified.
- .10 Design building enclosure elements to accommodate movement in wall and structural movements without permanent distortion, damage to infills, racking of joints, breakage of seals, water penetration or glass breakage.
- .2 Building Envelope Performance Requirements:
  - .1 Adhere to rainscreen principals and allow for and ensure proper drainage of wall systems to the exterior.
  - .2 Provide thermally-broken connections to structure, or use other means equally effective, to limit thermal transmission from exterior past the thermal control layer to the interior.
  - .3 Effective U-values of wall and roof assemblies shall meet or exceed the design requirements of OBC, and Supplementary Standard SB-10 ("SB-10") as amended.
  - .4 Maintain minimum insulating values as indicated for walls and roofs as noted on Drawings.
  - .5 Provide for positive drainage of condensation occurring within wall construction and water entering at joints, to exterior face of walls.

- .6 Vapour seal building enclosure to withstand, without failure, design RH at design ambient temperature condition, maintained against interior atmospheric pressure of 250 Pa.
- .7 Design, assemble and secure building elements to building frame to ensure stresses in sealants and seals are within sealant manufacturer's recommended maximum.
- .8 Maximum Allowable Air Infiltration Rates:
  - .1 Materials: air barrier system materials in the opaque enclosure shall have an air leakage rate not to exceed 0.02 L/s-m<sup>2</sup> under infiltration and exfiltration at a pressure differential of 75 Pa when tested in accordance with CAN/ULC S741.
  - .2 Assemblies: Air leakage rate not to exceed 0.2 L/s-m<sup>2</sup> under infiltration and exfiltration at a pressure differential of 75 Pa when tested in accordance with CAN/ULC S742.
  - .3 Whole Building Air Tightness: Air leakage rate of the building enclosure shall not exceed 1.5 L/s under infiltration and exfiltration at a pressure differential of 75 Pa per m<sup>2</sup> of the building shell when tested according to ASTM E3158 following the multi-point test protocol outlined in the U.S. Army Corps of Engineers Air Leakage Test Protocol for Building Envelopes. Test to be an air barrier systems enclosure test and exclude HVAC related openings.
- .9 Maximum Allowable Water Penetration Rates
  - .1 Roofs: no water penetration when tested in accordance with ASTM E1646 at test pressure difference of 135 Pa.
  - .2 Walls: no water penetration when tested in accordance with ASTM E331 at a minimum differential pressure of 300 Pa.

## 2.3 MATERIALS

- .1 Structural Steel: refer to structural design Drawings, and reviewed engineered Shop Drawings, and provide as required.
- .2 Exposed steel to be prime-coated and finish-painted, to Section 09 91 00 and as specified herein.
- .3 Standing Seam Metal Roofing: to Section 07 61 13 – Standing Seam Sheet Metal Roofing, and as per Drawings; with the exception of the insulation, this roofing system is part of the pre-engineered building 'Supplier' scope, including all connections, transitions and interfaces. The Consultant shall select the roofing system to be installed from the pre-engineered building 'Supplier' full range of options. Provide all structure as required for a complete roof installation as indicated and as per reviewed engineered Shop Drawings. Coordinate and cooperate with photovoltaic system installer as required.

- .4 Wall Cladding and Liner Panels: to Section 07 46 19 - Preformed Metal Cladding, and as per Drawings; this cladding system is part of the pre-engineered building 'Supplier' scope, including all connections, transitions and interfaces. The Consultant shall select the cladding system to be installed from the pre-engineered building 'Supplier' full range of options.
  - .1 Fasteners: Provide 'Supplier' standard fastenings for attaching cladding to structural framing and for attaching flashing, trim, and other sheet metal work using zinc coated or zinc equivalent carbon steel fasteners shall have a minimum coating thickness of 0.008 mm.
  - .2 At metal cladding, provide 25 mm slotted, vented, drained Z-girts as required.
- .5 Wall type W-EX1, provide all girts and structure as required, as per Drawings, and as per reviewed engineered Shop Drawings.
- .6 As indicated at wall type W-EX1, provide minimum R10 rigid board closed-cell extruded polystyrene insulation, complete with taped and sealed joints, with all penetrations sealed; purpose: to form a combined thermal, air and moisture barrier.
- .7 As indicated at wall type W-EX1, provide fibrous insulation, to ULC S702.1, as required to fill entire girt cavity. Provide insulation netting as required to hold fibrous insulation in place while other work is being erected and installed.
- .8 As indicated at wall type W-P2a, provide steel stud framing, fibrous insulation, to ULC S702.1, as required to fill entire stud cavity, and steel liner panels.
- .9 Allow for and accommodate all doors and windows interfacing with pre-engineered building construction. Cooperate and coordinate with window and door trades as required to ensure the logical sequencing of the work to meet the construction schedule, and for the proper installation of exterior doors and windows, and as required to maintain the continuity of the thermal, air and vapour control layers.
- .10 Bituminous Isolation Coating: cold-applied bituminous mastic, paint or aerosol, formulated to provide a separation between different types of metals, and metal to concrete; compounded to provide a minimum 0.4 mm dry film thickness per coat; inert type non-corrosive compound free of asbestos fibres, sulphur components, and other deleterious impurities.
- .11 Non-Metallic, Shrink-Resistant Grout: Factory-packaged, non-metallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time in accordance with ASTM C1107.
- .12 Metal Panel Sealants:
  - .1 Sealant Tape: Pressure sensitive, 100% solids, grey polyisobutylene compound sealant tape with release paper backing; permanently elastic, non-sag, non-toxic, non-staining tape of 'Supplier' standard size.

- .2 Joint Sealant: premium, commercial non-sag silicone sealant, to Section 07 92 00, and of type, grade, class, and use classifications required to seal joints in metal-to-metal joints and remain weather tight, and as recommended by steel building 'Supplier' for conditions and building function.
- .13 Provide all other materials, accessories and ancillary products as required for a complete pre-engineered building installation as per 'Supplier' overall scope of work.

## **2.4 FINISHES**

- .1 Prefinished metal: Prefinished materials coated to film thickness as recommended by coating manufacturer, and designed specifically for vertical surfaces to 30 from vertical, and horizontal surfaces 5 up to 60 from horizontal and in accordance with ASTM A755 and as follows:
  - .1 Interior Finish: Manufacturer's standard silicone modified polyester (SMP) paint system.
    - .1 Colours: two (2) colours selected from full range of finish and colour options available from 'Supplier', and applied as noted on Drawings.
  - .2 Exterior Finish (walls and roof): Manufacturer's premium PVDF system to AAMA 2604.
    - .1 Provide three (3) colours selected from full range of finish and colour options available from 'Supplier', and applied as noted on Drawings.

## **2.5 FABRICATION**

- .1 Fabricate components of steel building system to tolerances, true dimensions and levels so that site erected parts will fit properly together in accordance with specified performance requirements in accordance with requirements of CSSBI 30M.
- .2 Fabricators of welded structural components shall be approved to the requirements of CSA W47.1, CSA W55.3, or both as applicable to the materials and components being welded.
- .3 Apply one coat of factory-applied primer to correctly prepared surfaces to all structural framing members in accordance with CISC 1-73a for surfaces intended for short-term temporary protection only, and MPI 107 for surfaces receiving site-applied finishes.
- .4 Coat or separate surfaces of dissimilar materials that are in contact with incompatible materials or other effective means to prevent corrosion.
- .5 Fabricate panels to thickness required by insulation value indicated on Drawings.
- .6 Fabricate panels from roll formed steel face and liner sheets chemically fused to a foamed in place rigid polyurethane expanded foam core as a single piece construction full height or stacked in multiple courses to suit design requirements for Work of the Contract.

- .7 Fabricate longitudinal edges of panel with roll formed male and female interlocking geometry fully supported by foamed in place insulation core with insulation core moulded into tongue and groove joint to allow positive insulation-to-insulation contact between panels to provide continuous thermal enclosure.
- .8 Maintain integrity of air, vapour and thermal barriers throughout building enclosure elements; locate vapour barrier on warm side of thermal insulation.
- .9 Provide a complete enclosure assembly with exterior skin, vision units, access units, inner air/vapour seal, thermal insulation and interior finish.
- .10 Accurately fit and rigidly frame together joints, corners and mitres.
  - .1 Match components carefully to produce continuity of line and design.
  - .2 Make joints and connections toward exterior weather tight.
  - .3 Provide hairline joints for materials in contact.
  - .4 Coordinate location of visible joints.

## **2.6 ACCESSORIES**

- .1 Accessories: metal building 'Supplier' and panel system manufacturer's thermal girts, accessories, fasteners, materials and components as required for a complete and functional installation.
- .2 Gutters, downspouts, flashings, enclosures and trim: matching material and colour of exterior metal cladding, coordinate requirements with Section 07 62 00.
- .3 Fasteners: concealed type; in joint hex or pan headed fasteners.
- .4 Washers: concealed type; weather tight.
- .5 Liquid sealants: non-curing, pressure-resistant type; for use within internal panel joints, coordinate requirements with Section 07 92 00.
- .6 Preformed Sealants: Preformed silicone sheets; for use in transition joints between wall panels and adjacent construction, coordinate requirements with Section 07 92 00.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Erect steel building assembly in accordance with the reviewed engineered Shop Drawings, the specifications of the pre-engineered building 'Supplier', and as required to meet or exceed requirements of CSSBI 30M, and as required to achieve certification under CSSBI C1.
- .2 Work must meet or exceed the requirements of the OBC and instructions or directions of authorities having jurisdiction.

### **3.2 EXAMINATION**

- .1 Examine substrates, areas, and conditions to verify requirements for installation tolerances and other conditions affecting performance of work; coordinate requirements to correct conditions detrimental to performance of work.
- .2 Survey elevations and locations of concrete and masonry bearing surfaces and locations of anchor bolts, bearing plates, and other embedments receiving structural framing to verify requirements and steel building system tolerances before erection proceeds.

### **3.3 PREPARATION**

- .1 Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads.
- .2 Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

### **3.4 ERECTION**

- .1 Do not site cut, drill, or alter structural members without written approval from the delegated design P.Eng. engaged by the 'Supplier' to prepare the engineered Shop Drawings and perform field reviews.
- .2 Set structural framing accurately in locations and to elevations indicated; maintain structural stability of frame during erection.
- .3 Clean bearing surfaces of bond reducing materials, and roughen surfaces prior to setting plates; clean bottom surface of plates and as follows:
  - .1 Set plates for structural members on wedges, shims, or setting nuts as required.
  - .2 Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - .3 Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
  - .4 Neatly finish exposed surfaces; protect grout and allow to cure.
  - .5 Install shrink resistant grouts in accordance with grout manufacturer's written installation instructions.
- .4 Align and adjust structural framing before permanently fastening; clean bearing surfaces and other surfaces that will be in permanent contact with framing before assembly; perform necessary adjustments to compensate for discrepancies in elevations and alignment, and as follows:
  - .1 Level and plumb individual members of structure.
  - .2 Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
  - .3 Erect steel building system framing to tolerances listed in CAN/CSA S16; having a variance not exceed 1:500.

- .5 Erect structure, enclosure and other in-scope elements to provide a complete, rigid, insulated and weather tight, and functional building in accordance with CSSBI S10 and S11, and as follows:
  - .1 Coordinate installation of flashing and other components.
  - .2 Seal perimeter of frames with elastomeric sealant used for metal wall panels.
  - .3 Install surface-mounted items after finishes have been completed on substrates involved; set units level, plumb, and true to line and location; adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - .4 Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
  - .5 Install components required for a complete enclosure assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - .6 Install flashing and trim in accordance with SMACNA Architectural Sheet Metal Manual using concealed fasteners where possible with units set true to line and level with laps, joints, and seams permanently watertight and weather resistant in final construction; include for thermal expansion of exposed flashing and trim.
  - .7 Install gutters and downspouts with riveted and soldered, or lapped and sealed joints; attach gutters to eave with hangers spaced not more than 1200 mm o.c. using fabricator's standard fasteners; join downspouts with telescoping joints using fasteners designed to hold downspouts securely 25 mm away from walls evenly spaced and no more than 1500 mm o.c. between fasteners.
  - .8 Provide elbows at base of downspouts to direct water away from building.
  - .9 Connect downspouts to civil site storm water system as indicated; refer to Drawings; coordinate and cooperate with other trades as required for proper connections.
  - .10 Ensure grade slopes 2% away from building at soft landscape areas.

### **3.5 FIELD QUALITY CONTROL**

- .1 Obtain written report from steel building system 'Supplier' certifying that work was handled, erected, installed, applied, protected and cleaned in accordance with requirements of this Section.
- .2 Provide Certificate in accordance with CCSBI C1 and CSA A660, signed and sealed by a profession engineer (P.Eng.) registered in the Province of Ontario indicating that steel building systems specified in this Section are in accordance with requirements of this Section, the Ontario Building Code, and requirements of authorities having jurisdiction.



- .3 Provide field testing as required to verify that water and air leakage specifications have been met; refer to Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
  - .1 Perform at least one water leakage test and one air leakage at each elevation at locations chosen by Consultant.
  - .2 Perform water and air leakage tests at metal roofing, one of each.
  - .3 Perform whole building air leakage test to verify compliance with specifications.

### **3.6 CLEANING AND PROTECTION**

- .1 Repair damaged galvanized coatings on galvanized items with galvanized repair paint in accordance with ASTM A780 and 'Supplier' written instructions.
- .2 Promptly clean, prepare, and prime or re-prime site connections, rust spots, and abraded surfaces of prime painted structural framing, bearing plates, and accessories after erection and as follows:
  - .1 Clean and prepare surfaces by SSPC SP 2 or SSPC SP 3 as applicable to prime paint manufacturer's instructions.
  - .2 Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- .3 Remove temporary protective coverings and strippable films as metal panels are installed and as follows:
  - .1 On completion of metal panel installation, clean finished surfaces as recommended by metal panel 'Supplier'. Maintain in a clean condition during construction.
  - .2 Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touch-up or similar minor repair procedures.
- .4 Clean exposed surfaces of louvers that are not protected by temporary covering, to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning, and as follows:
  - .1 Restore louvers damaged during installation and construction period so no evidence remains of corrective work; remove and replace damaged units where restoration is unsuccessful, as determined by Consultant.
  - .2 Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory applied finish coating.
- .5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt in accordance with the requirements of Section 01 74 11 – Cleaning.

- .6 Manage, dispose and recycle construction waste materials in accordance with the requirements of Section 01 74 19 - Waste Management and Disposal.

**3.7 SCHEDULE**

- .1 Install as indicated on Drawings, and in accordance with reviewed engineered Shop Drawings.

**END OF SECTION**

## Division 22 Plumbing

### **Plumbing Contract Requirements for Mechanical**

22 02 51 Plumbing Contract General Requirements

### **Plumbing Work Results for Mechanical**

22 05 11 Plumbing Work Requirements  
22 05 19 Thermometers and Pressure Gauges  
22 05 31 Expansion Fittings and Loops  
22 05 34 Plumbing Bases, Hangers, and Supports (Indoor)  
22 05 48 Plumbing Seismic Restraint  
22 05 49 Plumbing Vibration Control Measures  
22 05 53 Identification of Plumbing Services

### **Common Work Results for Plumbing**

22 06 33 Heat Tracing for Plumbing & Drainage

### **Plumbing Insulation**

22 07 19 Plumbing Piping Insulation

### **Facility Water Distribution**

22 11 16 Domestic Water Piping – Copper  
22 11 22 Domestic Water Circulation Pump  
22 11 31 Potable Water Auxiliary Equipment

### **Facility Sanitary Sewerage**

22 13 13 Sanitary Drains  
22 13 17 Sanitary Waste and Vent Piping – Plastic  
22 13 24 Underground Oil Interceptor  
22 14 16 Storm Drainage Piping – Plastic

### **Domestic Water Softeners**

22 31 13 Domestic Water Softeners

### **Electric Domestic Water Heaters**

22 33 33 Electric Domestic Water Heaters and Trim

### **Plumbing Auxiliary Equipment**

22 36 13 Plumbing Auxiliary Equipment

### **Fire Extinguishers**

22 37 13 Portable Fire Extinguishers

### **Plumbing Fixtures Combined With Drawing Schedule**

22 44 13 Plumbing Fixtures Combined With Drawing Schedule

### **Compressed Air**

22 75 13 Compressed Air Systems

## **Division 23 Heating, Ventilating, and Air Conditioning (HVAC)**

### **HVAC Contract Requirements for Mechanical**

23 02 51 HVAC General Requirements

### **HVAC Work Results for Mechanical**

23 05 11 General HVAC Work Requirements  
23 05 19 Thermometers and Pressure Gauges  
23 05 31 Expansion Fittings and Loops  
23 05 34 Bases, Hangers and Supports (Indoor)  
23 05 48 HVAC Seismic Restraint  
23 05 49 Vibration Control Measures  
23 05 53 Identification of HVAC Services

### **HVAC Insulation**

23 07 13 Duct Insulation  
23 07 19 HVAC Piping Insulation

### **Facility Fuel Piping**

23 11 23 Facility Natural Gas Piping

### **Hydronic Piping and Pumps**

23 21 11 Hydronic Accessories  
23 21 13 Hydronic Piping - Screwed/Welded  
23 21 23 Pumps Hydronic

### **Refrigerant Piping**

23 23 13 Refrigerant Piping and Specialties

### **HVAC Water Treatment**

23 25 13 Water Treatment for Closed-Loop Hydronic Systems

### **HVAC Ducts and Casings**

23 31 13 Metal Ducts

### **Air Duct Accessories**

23 33 13 Duct Accessories  
23 33 14 Volume Control Dampers  
23 33 16 Fire Dampers  
23 33 18 Operating Dampers  
23 33 46 Flexible Ducts  
23 33 53 Duct Liners

### **HVAC Fans**

23 34 23 Packaged Exhausters

### **Air Outlets and Inlets**

23 37 13 Diffusers, Registers, and Grilles  
23 37 23 Louvres and Vents for Intake and Exhaust

### **Ventilation Hoods**

23 38 13 Light Commercial Kitchen Hood Systems

	<b>Heating Boilers</b>
23 52 17	Wall Mounted Condensing Boilers
	<b>Heat Exchangers for HVAC</b>
23 57 19	Liquid to Liquid Heat Exchangers
	<b>Decentralized Unitary HVAC Equipment</b>
23 81 23	Computer Room Air Conditioners
23 81 26	Split-System Heat Pump
23 81 44	Air Source Heat Pump
	<b>Convection Heating and Cooling Units</b>
23 82 19	Fan Coil Units (Heating or Cooling)
23 82 39	Hydronic Unit Heaters
	<b>Radiant Heating Units</b>
23 83 12	Electric Duct Heaters
23 83 17	Hydronic Infloor Heating

## **Division 25 Integrated Automation**

	<b>General Requirements for Integrated Automation</b>
25 02 05	Integrated Automation General Requirements
	<b>Common Work Results for Integrated Automation</b>
25 05 11	Variable Frequency Drives
25 05 21	Gas Detection Devices
	<b>Building Automation System</b>
25 20 02	Network Architecture and Wiring
25 20 03	Operator Interface
25 20 04	Controllers
25 20 05	Field Devices and Sensors
25 20 06	Application and Systems Sequences of Operation

**END OF SECTION**

**Part 1            General**

**1.1            GENERAL PROVISIONS**

- .1      This section covers items common to all sections of the Plumbing Division.
- .2      Conform to Division 1 General Conditions.
- .3      Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.
- .4      Unless specifically indicated, all materials and equipment provided under this contract shall be new and shall be manufactured in the project year.
- .5      The term “Mechanical Contractor” shall remain active and shall mean a “single contractor” performing plumbing, drainage, heating, cooling, ventilation, and control services.
- .6      When quoting as a subcontractor this contractor shall explicitly state the services they are providing i.e. Mechanical (all services), Plumbing (water and drainage systems) or HVAC (including hydronic and air systems).
- .7      Contractors shall be explicit to identify whether Fire Protection is included or omitted from the mechanical scope.

**1.2            INTENT**

- .1      Mention herein or indication on Drawings of articles, materials, operations or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and, performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for plumbing work.
- .2      Where used, words “Section” and “Division” shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.
- .3      Where used, word “supply” shall mean furnishing to site in location required or directed complete with accessory parts.
- .4      Where used, word “install” shall mean secured in place and connected up for operation as noted or directed.
- .5      Where used, word “provide” shall mean supply and install as each is described above.

**1.3            TENDERS AND BONDING**

- .1      Submit tender based on specified described equipment or Alternates listed.

**1.4            REGULATIONS, PERMITS, AND FEES**

- .1      All materials and quality of work shall meet all current and latest Provincial, Municipal and Fire Marshall requirements, regulations, codes, and by-laws in force in the area of the project.

- .2 Each contractor shall give all necessary notices, obtain all necessary permits, and pay all fees in order that the work shown or specified may be carried out. Each contractor shall furnish any certificates necessary as evidence that the work installed conforms with the laws and regulations of all authorities having jurisdiction.
- .3 In the event that changes, or alterations are required on completed work by authorized inspectors, these changes shall be made at the contractor's expense.
- .4 Special equipment which does not have a standard CSA label shall be inspected by the local electrical authority having jurisdiction and the Approval Certificate shall be submitted to the Consultant as soon as possible. All costs and fees for inspections shall be borne by this contractor.

## **1.5 DRAWINGS**

- .1 The drawings and specifications are not assembled together for responsibility/division between subcontractors. The division of work between subcontractors remains the responsibility of the buildings' contractor (also known as the prime contractor or general contractor).
- .2 All subcontractors are encouraged to perform work amicably utilizing all of the drawings and specifications published by all of the consultants.
- .3 Plumbing and Mechanical Drawings do not show structural and architectural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes, or additions to runs of piping, conduits, and ducts to accommodate structural conditions. Location of pipes, ducts, conduits and other equipment may be altered by Consultant without extra charge provided change is made before installation and does not necessitate major additional material.
- .4 As work progresses and before installing piping, ductwork, heating units, registers, diffusers, fixtures and any other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings, or obtain directions for exact location of such equipment and fittings.
- .5 Plumbing and Mechanical Drawings indicate general location and route of pipes, ducts and conduits which are to be installed. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Follow building lines, conceal piping, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.
- .6 Install piping and ductwork to clear structural members and any fireproofing. Locate plumbing work to permit installation of specified insulation. Do not remove or damage structural fireproofing. Leave space to permit fireproofing and insulation to be inspected and repaired.
- .7 Before commencing work, check and verify all sizes, locations, grade and invert elevations, levels, and dimensions to ensure proper and correct installation. Verify existing/municipal services.

- .8 Locate all plumbing, mechanical, and electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.
- .9 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install piping and other work so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.
- .10 Relocate equipment and/or material installed but not coordinated with work of other Sections and/or installed incorrectly as directed, without extra charge.
- .11 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

#### **1.6 INTERFERENCE AND COORDINATION DRAWINGS**

- .1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the constructed spaces provided.
- .2 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.
- .3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.
- .4 Upon consultant's request submit copies interference drawings to consultant.
- .5 Due to the nature of the building and the complexity of the building systems provide the following:
  - .1 Interference drawings, showing coordination of architectural, structural, plumbing, mechanical, and electrical systems for the consultant's review prior to fabrication.
  - .2 Detailed layout drawings, clearly showing fasteners and hangers.
- .6 Provide CAD drawings (minimum file version AutoCAD 2013) in addition to hard copies.

#### **1.7 QUALITY ASSURANCE**

- .1 Perform work in accordance with applicable provisions of local Plumbing Code, Gas Ordinances, and adoptions thereof for all plumbing systems. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
- .2 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify Consultant in writing of such differences.

#### **1.8 ALTERNATES AND SUBSTITUTIONS**

- .1 Throughout the Plumbing Divisions and Mechanical Divisions are lists of "Acceptable Alternative" manufacturers acceptable to Consultant if their product meets characteristics of specified described equipment. Submitted Bids shall be based on the supply of named articles and or products as specified in the Bid Documents.



- .2 Each bidder may elect to use “Acceptable Alternative” where listed. Include for any additional costs including all costs for revisions to electrical contract to suit Alternative used.
- .3 When two or more suppliers/manufacturers are named in the Bid Documents, only one supplier/manufacture of the products named will be acceptable; however, it is the responsibility of this Division to ensure “Alternate Equipment” fits space allocated and gives performance specified. If an “Alternate Equipment” nor “equal” specified product unit is proposed and does not fit space allotted in Consultant’s opinion, supply of specified described equipment will be required without change in Contract amount. Should electrical characteristics for “alternate” or “equal” equipment differ from equipment specified it shall be the responsibility of the equipment manufacturer to pay all costs associated with the revisions to the electrical contract. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.
- .4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.
- .5 If pipe or item, of size or weight indicated, is unobtainable, supply next larger size or heavier weight without additional charge.

## **1.9 EXAMINATION**

- .1 Site Reviews
  - .1 Examine premises to understand conditions, which may affect performance of work of this Division before submitting proposals for this work.
  - .2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- .2 Drawings:
  - .1 Plumbing and Mechanical Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
  - .2 Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing, Mechanical, and Fire Protection Drawings.
  - .3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- .3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

**1.10 SEQUENCING SCHEDULING AND COORDINATION**

- .1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Consultant. Should conditions arise where certain changes would be advisable, secure Consultant's approval of these changes before proceeding with work.
- .2 Coordinate work of various trades in installing interrelated work. Before installation of plumbing items, make proper provision to avoid interferences in a manner approved by Consultant. Each Contractor shall refer to all sections of the specification for their responsibilities with other trades. Changes required in work specified in Plumbing Division caused by neglect to do so shall be made at no cost to Owner.
- .3 Arrange pipes, ducts, and equipment to permit ready access to valves, unions, traps, starters, motors, control components, and to clear openings of doors and access panels.
- .4 Furnish and install inserts and supports required by Plumbing Division unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by Plumbing Division.
- .5 Be responsible for required excavation, backfilling, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.
  - .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
  - .2 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
  - .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .6 Adjust locations of pipes, ducts, equipment, fixtures, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.
  - .1 Make offsets, transitions, and changes in direction of pipes, ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
  - .2 Furnish and install traps, air vents, sanitary vents, pull boxes, etc, as required to effect these offsets, transitions, and changes in direction.

- .7 Slots and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

#### **1.11 REQUEST FOR INFORMATION (RFI) PROCEDURES**

- .1 RFIs shall be submitted to the consultant minimum two (2) weeks prior to answer being required. Failure to submit an RFI in a timely manner will forfeit delay claims and schedule extension requests by the contractor.
- .2 All RFIs will be submitted with the following information:
  - .1 RFI number
  - .2 Name of project
  - .3 Date of initiation
  - .4 Date response required by (minimum two (2) weeks)
  - .5 Subject
  - .6 Submitter's name
  - .7 Drawing/specification reference
  - .8 Photograph of the issue (if applicable)
  - .9 Description of the issue
  - .10 Contractor's proposed resolution

#### **1.12 CONTRACT BREAKDOWN**

- .1 Provide breakdown of mechanical contract exclusive of HST to acceptance of consultants prior to first draw submission.
- .2 Provide labour and material cost for each item.
- .3 Breakdown shall indicate total contract amount.
- .4 Contract breakdown shall be as follows as a minimum.
  - Mobilization and shop drawings (max \$2000.00)
  - Demolition
  - Inside buried plumbing and drainage
  - Above grade rough-in plumbing and drainage
  - Roof drainage system
  - Plumbing Fixtures
  - Plumbing Equipment
  - Specialty Piping
  - Piping Insulation
  - Fire Stopping
  - Plumbing contractor closeout requirements (min. of 3% for the first \$500,000.00, 1% from \$500,000.00 to \$5,000,000.00, and 0.5% beyond. Shall not be less than \$5,000.00)
- .5 Progress claims, when submitted are to be itemized against each item of the contract breakdown, this shall be done in table form showing contract amount, work complete to date, previous draw, amount this draw and balance.

- .6 Mobilization amount may only be drawn when all required shop drawings have been reviewed by the consultant.**

**1.13 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Furnish complete catalog data for manufactured items of equipment to be used in the Work to Consultant for review within 14 days after award of Contract.
- .2 Upon receipt of reviewed shop drawing, product is to be ordered immediately.
- .3 Provide a complete list of shop drawings to be submitted prior to first submission.
- .4 Before submitting to the Consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The Contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.
- .5 If material or equipment is not as specified or submittal is not complete, it will be rejected by Consultant.
- .6 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.
- .7 Submit all shop drawings for the project as a package. Partial submittals will not be accepted.**
- .8 Catalog data or shop drawings for equipment, which are noted as being reviewed by Consultant or their Engineer shall not supersede Contract Documents.
- .9 Review comments of Consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless Consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- .10 Check work described by catalog data with Contract Documents for deviations and errors.
- .11 Shop drawings and product data shall show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances. e.g., access door swing spaces.
- .12 Shop drawings and product data shall be accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify as to current model production.
  - .5 Certification of compliance to applicable codes.

- .13 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.
- .14 Shop drawings shall be submitted electronically as per the following directions:
  - .1 Electronic Submissions:
    - .1 Electronically submitted shop drawings shall be prepared as follows:
      - .1 Use latest software to generate PDF files of submission sheets.
      - .2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.
      - .3 PDF format shall be of sufficient resolution to clearly show the finest detail.
      - .4 PDF page size shall be standardized for printing to letter size (8.5" x 11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11" x 17".
      - .5 Submissions shall contain multiple files according to section names as they appear in Specification.
      - .6 File names shall include consultant project number and description of shop drawing section submitted.
      - .7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.
      - .8 On the shop drawing use an "electronic mark" to indicate what is being provided.
      - .9 **Each file shall bear an electronic representation of the "company stamp" of the contractor. If not stamped the file submission will not be reviewed.**
    - .2 Email submissions shall include subject line to clearly identify the consultants project number and the description of the shop drawings submitted.
    - .3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating "1 of 2" and "2 of 2" in email subject line for the case of two messages.
    - .4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.
    - .5 On site provide one copy of the "reviewed" shop drawings in a binder as noted above.
    - .6 Contractor to print copies of "reviewed" shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

**1.14 EQUIPMENT NAMEPLATE DATA**

- .1 Between the manufactures design published literature, the shop drawing submission literature, and the nameplate data on the equipment, they can all read differently.
- .2 Most of the confusion and differences are coming out of the electrical power installation.
- .3 The contractors installing and connecting the equipment are responsible for the coordination of this data through the construction period.
- .4 The contractors shall share and/or request this information through out the project and monitor/make adjustments, provide recommendations accordingly based on any discrepancies.
- .5 The contractors are responsible for any cost associated with the changing data.
- .6 The final installation must meet the “Nameplate Data” on the equipment on site.

**1.15 OPERATION AND MAINTENANCE MANUAL**

- .1 Provide operation and maintenance data for incorporation into manual as in submittals' requirements.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.
- .3 Submit 1 copy of Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless so directed by Consultant. Submission can be done electronically in pdf format or as a hardcopy.
  - .1 Electronic submission/pdf file is required to be bookmarked. Any submission received without bookmarking will be immediately returned as unacceptable.
  - .2 Hardcopy submission shall be in a three-ring binder (minimum 50 mm (2") ring) and labelled as 'Mechanical Operation and Maintenance Manual' with project name and location. Dividers are to be used for binder organization.
- .4 Make changes as required and re-submit as directed by Consultant.
- .5 Operation data to include:
  - .1 Control schematics for each system including environmental controls.
  - .2 Description of each system and its controls.
  - .3 Operation instruction for each system and each component.
  - .4 Description of actions to be taken in event of equipment failure.
  - .5 Valves schedule and flow diagram.
  - .6 Colour coding chart.
  - .7 Spare parts equipment list.
  - .8 Manufacturers standard or extended warranty information.
- .6 Maintenance data shall include:
  - .1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.

- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .7 Performance data to include:
  - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified elsewhere.
  - .4 Testing, adjusting and balancing reports as specified in Testing, Adjusting and Balancing Section.
  - .5 Copy of all substantial performance final certificates.
- .8 Miscellaneous data to include:
  - .1 Letter of contractor's warranty and guarantee.
  - .2 Index sheet.
  - .3 Tabbed format for each section.
  - .4 Manufacturers approved shop drawings.
  - .5 Spare parts list and source.
  - .6 List of Manufacturers and suppliers address for each piece of equipment.
- .9 Final Submittals:
  - .1 Upon acceptance of Operation and Maintenance Manual by the Consultant provide the following:
    - .1 Provide two (2) copies of final operation maintenance manuals, as well as a PDF file of the entire approved manual on a USB stick. Only one USB stick is to be provided containing both the approved manual and as-built drawings.

#### **1.16 AS-BUILT DRAWINGS**

- .1 Site records:
  - .1 Contractor shall provide two (2) sets of reproducible plumbing drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing plumbing systems, control systems, and low voltage control wiring.
  - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection at all times.
- .2 As-Built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW PLUMBING SYSTEMS AS INSTALLED" (Signature of Contractor) (date).

- .3 TAB to be performed using as-built drawings.
  - .1 Submit hard copy to Consultant for approval. When returned, make corrections as directed.
  - .2 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy on USB stick with Operating and Maintenance Manuals.

#### **1.17 WARRANTIES**

- .1 In addition to guarantee specified in General Conditions, guarantee plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
- .2 Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record "start-up" date of each piece of equipment on certificate. Include certificates as part of Operation & Maintenance Manual.

Warranty period shall start from date of ready for takeover. Warranty start date based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .4 Warranty Duration:
  - .1 Two (2) year warranty period applies unless otherwise noted.
- .5 Warranty Coverage:
  - .1 Applies to parts and labour.

#### **1.18 OCCUPANCY REQUIREMENTS**

- .1 The contractor shall provide the following documentation to the consultant's satisfaction prior to receiving occupancy. Failure to provide the proper documentation will result in the occupancy not being granted. List of required documentation:
  - .1 Final Certificates (required prior to consultant's release of conformance letter).
    - .1 Dry chemical fire suppression system test and verification (data room)
    - .2 Potable Water Test (Refer to domestic water piping – Copper section – Part 3)
    - .3 Backflow Test Certificate (for all testable devices)
    - .4 Seismic Restraint Engineers' Letter
    - .5 TSSA certificate of inspection for compressed air system.

#### **1.19 READY FOR TAKEOVER**

- .1 Complete the following to the satisfaction of the consultant prior to request for ready for takeover.
  - .1 As-Built Drawings.
  - .2 Maintenance Manuals
  - .3 System Start up



- .4 TAB Reports
- .5 HVAC System Commissioning
- .6 Instructions to Owners

**1.20 REVISION TO CONTRACT**

- .1 Provide the following:
  - .1 Itemized list of material with associated costs.
  - .2 Labour rate and itemized list of labour for each item.
  - .3 Copy of manufacturers/supplier's invoice if requested.

**1.21 DELIVERY, STORAGE, AND HANDLING**

- .1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials. Contractor to include all costs associated with delivery storage and handling in tender price.
- .2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or environmental damages but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.
- .3 Remove all damaged materials from site.

**1.22 CONFINED SPACES**

- .1 Certain areas of the building may be defined as a "Confined Space". Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.
- .2 Refer to building documentation for any spaces deemed "Confined Space".

**1.23 ENERGY EFFICIENCY**

- .1 All equipment must meet the efficiency of equipment listed in the design and must meet ratings specifically indicated in design documents. This project is energy modeled, and listed equipment energy efficiency must be achieved for funding purposes. Lower efficiency equipment will not be accepted.
- .2 The systems of this building must achieve the energy efficiency levels by conforming to ANSI/ASHRAE/IESNA 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings" and Chapter 2 of Division 3 of SB-10 prescriptive method from the Ontario Building Code.
- .3 All equipment, products, and installations must conform to the Codes and Standards.

**END OF SECTION**

**Part 1            General**

**1.1            TESTS**

- .1 Give 48 hours written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by Consultant.
- .3 Conduct tests in presence of Consultant.
- .4 Bear costs including retesting and making good.
- .5 Piping:
  - .1 General: maintain test pressure without loss for 4 h unless otherwise specified.
  - .2 Test drainage, waste and vent piping to Ontario Building Code and authorities having jurisdiction.
  - .3 Test domestic hot, cold and recirculation water piping at 1-1/2 times system operating pressure or minimum 860 kPa (124.8 psi), whichever is greater.
- .6 Equipment: test as specified in relevant sections.

**1.2            SYSTEM START UP**

- .1 Provide adjusting testing and start up of all equipment prior to testing and balancing (TAB) specified elsewhere.
- .2 Provide consultant with written notice verifying all equipment operation and installation is complete.
- .3 Start up shall be in presence of the following: owner or representative, contractor, building automation systems (BAS) contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.
- .4 Simulate system start up and shut down and verify operation of each piece of equipment.
- .5 Arrange with all parties and provide 72 hours notice for start up procedure.
- .6 Arrange with building automation systems contractor to sequence all components and ensure system operation.

**1.3            DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTION**

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Plumbing contractor to schedule and coordinate the demonstration all on the same day, starting at a pre-approved time and continuing consequently until complete.
- .3 Where specified elsewhere in this Division, qualified manufacturers' representatives who are knowledgeable about the project to provide demonstrations and instructions.

- .4 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Where deemed necessary, Consultants may record these demonstrations on video tape for future reference.

#### **1.4 TRIAL USAGE**

- .1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 Domestic water
  - .2 Plumbing and drainage.

#### **1.5 DEFICIENCIES**

- .1 During the course of construction, the consultants will monitor construction and provide written reports of work progress, discussions, and instruction to correct work.
- .2 Instruction to correct work shall be done within the work period before the next review.
- .3 The contractor shall not conceal any work until inspected.
- .4 The contractor shall expedite 100% complete rough-in work and have inspected prior to concealing services and equipment especially above ceiling.
- .5 Upon completion of the project the consultant will do a final review. Upon receiving the final inspection report, the contractor must correct and sign back the inspection report indicating the deficiencies are completed. A re-inspection will only be done once consultant receives this in writing.

#### **1.6 EQUIPMENT INSTALLATIONS**

- .1 Unions or flanges: provide for ease of maintenance and disassembly.
- .2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.
- .3 Equipment drains: pipe to floor drains.
- .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

#### **1.7 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

- .3 Install plumbing equipment at following heights unless indicated otherwise.
- |     |                                 |   |
|-----|---------------------------------|---|
| .1  | Standard water closets          | 350 (14") to top of bowl  |
| .2  | Barrier-free water closets      | 400 (16") to top of bowl  |
| .3  | Barrier-free water closets      | 450 (18") to top of seat lid  |
| .4  | Wall hung lavatory              | 787 (31") to rim  |
| .5  | Barrier-free wall hung lavatory | 840 (33") max to top of rim<br>737 (29") min underside of rim front<br>685 (27") clear at 400 (8") from basin front<br>350 (14") min clear under waste trap |
| .6  | Urinals (Adult)                 | ± 600 (24)  |
| .7  | Hose bibbs                      | +/- 600 (24")   |
| .8  | Shower heads (Standard)         | 2.0 m (6' – 6") to bottom of head<br>Shower heads (Barrier-free)<br>adjustable from 1200 (48") to 2030 (80")  |
| .9  | Barrier-free drinking fountains | 840 mm (33") to rim<br>Not less than 686 (27") under unit   |
| .10 | Backflow preventors             | 900 – 1200 (3'– 4') to centerline of unit   |

Also follow direction of architectural drawings and where discrepancies occur clarify prior to rough-in.

## **1.8 ANCHOR BOLTS AND TEMPLATES**

- .1 Supply anchor bolts and templates for installation by other Divisions.

## **1.9 PROTECTION OF OPENINGS**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

## **1.10 ELECTRICAL**

- .1 Electrical work to conform to Electrical Division including the following:
- |    |  |
|----|--|
| .1 | Supplier and installer responsibility and related plumbing responsibility is indicated in Equipment Schedule on plumbing/mechanical and/or electrical drawings.  |
| .2 | Power wiring and conduit is specified in Electrical Division except for conduit, wiring and connections below 50 V which are related to control systems. Follow Electrical Division for quality of materials and workmanship.  |
| .3 | Electrically operated equipment shall be C.S.A. approved label. Special Inspection Label of Provincial Authority having jurisdiction will be accepted in lieu of C.S.A. approval. Each motor shall have an approved starter. Starter will be supplied and installed by Electrical Division unless otherwise indicated. |
| .4 | <b>All starters for plumbing equipment to be provided by this contractor. Wired by Electrical Division.</b>  |

**1.11 CONTROL WIRING**

- .1 Furnish and install all components, devices, and control wiring for all plumbing, fire protection, HVAC equipment, HVAC systems, lighting, and other electrical loads to make all equipment operable to satisfaction of owner and consultant and to manufacturer's requirements and recommendations.
- .2 All electrical wiring and installations shall comply with local and national electrical codes.
- .3 Supply and install wiring as required for all devices and systems. Install wiring in EMT conduit and otherwise comply with all requirements of the Electrical Division. Approved plenum wire may be used for sensor and network communication wiring where it complies with appropriate building codes and regulatory authorities.
- .4 All wiring concealed in walls and chases, and all exposed wiring shall be run in conduit.
- .5 Provide recessed conduit and backer boxes where controls are wall mounted. Surface mounted boxes and conduit are acceptable in service rooms.
- .6 Free-run plenum rated cable shall be run in cable hangers where provided by Electrical Division or tied neatly to pipe and duct hangers in the ceiling. Avoid wiring that droops. Follow building lines and do not run wiring "as the crow flies".

**1.12 MOTORS**

- .1 Provide high efficiency motors for plumbing equipment.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motors under 373 W, (1/2 hp): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.
- .4 Motors 373 W, (1/2 hp) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated.

**1.13 PIPING AND EQUIPMENT SUPPORTS**

- .1 Fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings.
- .2 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. Concrete specified elsewhere.
- .3 Where housekeeping pads incorporate existing pads provide 10 mm dowels into existing pads. New pad height shall match existing.

**1.14 SLEEVES**

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated. Grout sleeves in place.
- .2 Schedule 40 steel pipe.

- .3 Sleeves with annular fin continuously welded at midpoint:
  - .1 Through foundation walls.
  - .2 Where sleeve extends above finished floor.
  - .3 Through fire rated walls and floors.
- .4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.
- .6 Fill voids around pipes:
  - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
  - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
  - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
  - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
  - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.
- .7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm clearance all around or to the requirements of the authority having jurisdiction. Seal at wall as indicated.

#### **1.15 FIRE STOPPING**

- .1 This contractor shall work with all other contractors on the project in providing one common method of fire stopping all penetrations made in fire rated assemblies.
- .2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- .3 Do not use cementitious or rigid seals around penetrations for pipe(s) or other equipment at all wall, floor, or ceiling penetrations.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barrier at fire separation.
- .5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- .6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- .7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
- .8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.

- .9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
- .11 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.
- .12 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.
- .13 Submit product literature and installation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and consultant.
- .14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
- .15 Acceptable Alternate Manufacturers to approval of local authority:
  - .1 Minnesota Mining and Manufacturing
  - .2 Fryseleeve Industries Inc.
  - .3 General Electric Pensil Firestop Systems
  - .4 International Protective Coatings Corp.
  - .5 Rectorseal Corporation (Metacaulk)
  - .6 Proset Systems
  - .7 3M
  - .8 AD Systems
  - .9 Hilti
- .16 Ensure firestop manufacturer representative performs onsite inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

#### **1.16 ESCUTCHEONS**

- .1 On pipes and ductwork passing through walls, partitions, floors and ceilings in exposed finished areas and on water and drain pipes inside millwork and cabinets.
- .2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
- .3 Outside diameter to cover opening or sleeve.
- .4 Inside diameter to fit around finished pipe.

#### **1.17 PAINTING**

- .1 Refer to Section Interior Painting and specified elsewhere.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

- .3 Apply two (2) coats of paint to exposed piping service in service room(s). Base colour as specified in Pipe Identification Section.
- .4 Prime and touch up marred finished paintwork to match original.
- .5 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

#### **1.18 ACCESS DOORS**

- .1 Mud-in type access doors provided by architectural division. Coordinate size and location with Architectural/General division.
- .2 Any additional access doors not accounted for in Architectural/General division shall be provided by this division. Provide access doors to concealed plumbing equipment for operating, inspecting, adjusting and servicing.
- .3 Flush mounted 600 x 600 mm (24" x 24") for body entry and 300 x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .4 Material:
  - .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.
  - .2 Remaining areas: use prime coated steel.
  - .3 Fire rated areas: provide ULC listed access doors.
  - .4 Washrooms or high moisture area ceilings: Aluminum with mill finish suitable for painting.
- .5 Installation:
  - .1 Locate so that concealed items are accessible.
  - .2 Locate so that hand or body entry (as applicable) is achieved.
- .6 Acceptable materials:
  - .1 Le Hage
  - .2 Zurn
  - .3 Acudor
  - .4 Nailor Industries Inc.

#### **1.19 DIELECTRIC COUPLINGS**

- .1 General:
  - .1 To be compatible with and to suit pressure rating of piping system.
  - .2 Where pipes of dissimilar metals are joined.
- .2 Pipes NPS 50 mm (2") and under: isolating unions.
- .3 Pipes NPS 65 mm (2 1/2") and over: isolating flanges.



**1.20 DRAIN VALVES**

- .1 Locate at low points and at section isolating valves unless otherwise specified.
- .2 Minimum NPS 20 mm (3/4") unless otherwise specified: bronze, with hose end male thread and complete with vacuum air breaker and chain with cap.
- .3 Drain valves on potable water systems shall be complete with vacuum breaker.

**1.21 REPAIRS, CUTTING, AND RESTORATION**

- .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
- .2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

**1.22 CLEANING**

- .1 Clean interior and exterior of all systems including strainers.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

**1.23 DISCONNECTION AND REMOVAL**

- .1 Disconnect and/or remove equipment, piping, etc. as indicated.
- .2 Cap and conceal all redundant and obsolete connections.
- .3 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site, which the owner does not retain.
- .4 Store equipment to be retained by owner on site where directed by consultant.

**1.24 OWNER SUPPLIED EQUIPMENT**

- .1 Refer to Division 1. Connect to equipment supplied by the owner and make operable.

**1.25 VIDEO RECORDING OF NEW UNDERGROUND SERVICES**

- .1 Prior to final acceptance of the new underground plumbing system and prior to pouring the floor this contractor shall retain a qualified contractor to video tape the new, existing and revised sanitary and storm drainage piping and branch piping. Transfer all videotape information to USB.
- .2 This contractor shall flush the new and existing storm and sanitary system to remove all debris prior to final video taping of systems.

- .3 Provide one (1) copy of USB.
- .4 Identify video routing on As-built drawings.

**1.26 LOCATION OF EXISTING UNDERGROUND SERVICES**

- .1 This contractor shall locate existing services prior to starting any work in the affected area.

**1.27 EXCAVATING AND BACKFILLING**

- .1 Refer to Division 31.
- .2 Provide all excavating and backfilling inside and outside the building for plumbing pipes, drains and equipment. All backfilling shall be new clean granular 'A' fill brought in specifically for the purpose of backfilling to the underside of floor slab. All backfilling shall be compacted at intervals not more than 150 mm (6") layer to the satisfaction of the Consultant.
- .3 Provide excavating and backfilling outside the building with granular A brought in specifically for backfilling to a minimum of 450 mm (18") over the pipe. Backfilling outside building over and above the 450 mm (18") backfill as previously specified herein shall be by the Plumbing Contractor as specified under Division 2. Where backfilling outside the building is not specified under Division 2 the plumbing contractor shall provide new clean granular 'A' fill to grade level.
- .4 Bottoms of trenches shall be excavated so that the pipe will be supported on a 150 mm (6") compacted bed of clean granular 'A' fill. Provide all necessary pumping to maintain excavation free of water.
- .5 Should water be encountered during excavation, the plumbing contractor shall provide all labour and material, including all equipment required for dewatering the excavation. After the water has been removed, this Contractor shall install a 300 mm (12") base of compacted 50 mm (2") clear stone covered with filter cloth before installing backfill as detailed and/or as specified.
- .6 Be responsible for all weather protection required to install piping and/or equipment to the satisfaction of the Consultant.
- .7 Be responsible for providing all clear stone or granular 'A' material suitable for application to replace existing soil not suitable for backfilling above the 450 mm (18") bedding material.

**1.28 CONFINED SPACES**

- .1 Certain areas of the building may be defined as a "Confined Space". Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.
- .2 Refer to building documentation for any spaces deemed "Confined Space".

**1.29 DOMESTIC HW SYSTEM BALANCING**

- .1 Meet all requirements as specified for balancing of hydronic systems.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Inlet and outlet of each heater, tank, pump, circulator, at each controller, controlled device.
- .3 At each circuit setter balancing valve.
- .4 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

**1.30 BALANCING OTHER PLUMBING SYSTEM**

- .1 Plumbing systems:
  - .1 Pressure booster systems: test for capacity and pressures under all conditions and at all times.
- .2 Recirculating Systems pump flows, pressures
- .3 Pumped sanitary and storm water systems: test for proper operation at all possible flow rates.

**1.31 COOPERATION WITH OTHER TRADES**

- .1 Give full cooperation to other trades and furnish in writing to other trades, with copies to the engineer, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- .2 Where plumbing work will be installed in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. Prepare composite working drawings and sections at a suitable scale, not less than ¼ inches = 1-foot – 0-inches, clearly showing how the plumbing work is to be installed in relation to the work of other trades. If work is installed before coordinating with other trades, or if it causes any interference with work of other trades, make the necessary changes in the work to correct the conditions and bear all costs.
- .3 Furnish to other trades necessary templates, patterns, setting drawings, and shop details for the proper installation of work and for coordinating adjacent work.

**1.32 WATERPROOFING SEAL MATERIALS**

- .1 Modular, expanding mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.
- .2 Standard of quality assurance manufacturers are:
  - .1 Thunderline Corp. (Power Plant Supply Co.) “Link Seal” Model S-316
  - .2 The Metraflex Co. “MetraSeal” type ES
  - .3 Or approved equivalent.

**1.33 SLEEVE, CUT, AND FORMED OPENING LOCATION DRAWINGS**

- .1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses, and formed openings in poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

**1.34 SUSTAINABLE CONSTRUCTION**

- .1 Construction Waste Management:
  - .1 Recycle all waste materials to avoid land fill sites where possible.
  - .2 All metal contents shall be recycled.
  - .3 All cardboard and paper shall be recycled.
  - .4 All plastic packaging shall be recycled.
  - .5 All wood shall be directed to the appropriate recycled wood section at the landfill site.
- .2 This contractor is responsible for their own waste management system and cost associated with the disposal. This can be their own on site system, daily removal, back to shop, or a communal system shared with other contractors on site.
- .3 In all cases the cost to remove materials on site are the cost of this contractor.

**1.35 FREEZE PROTECTION**

- .1 Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

**1.36 SCAFFOLDING, RIGGING, AND HOISTING**

- .1 Provide all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required. Conform to OSHA requirements and standards.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B40.100, Pressure Gauges and Gauge Attachments.
- .3 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .4 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Submit manufacturer's product data for following items:
  - .1 Thermometers.
  - .2 Pressure gauges.
  - .3 Stop cocks.
  - .4 Siphons.
  - .5 Wells.

**Part 2 Products**

**2.1 GENERAL**

- .1 Design point to be at mid point of scale or range.
- .2 Ranges: suitable for application.

**2.2 DIRECT READING THERMOMETERS**

- .1 Industrial, variable angle type, liquid filled, 225 mm (9") scale length: to CAN/CGSB 14.4.
  - .1 Acceptable materials:
    - .1 Trerice
    - .2 Winters 91T
    - .3 Wiess

**2.3 REMOTE READING THERMOMETERS**

- .1 100 mm (4") diameter liquid filled activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.
  - .1 Acceptable materials:
    - .1 Trerice
    - .2 Winters Contractor

## **2.4 THERMOMETER WELLS**

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

## **2.5 PRESSURE GAUGES**

- .1 115 mm (4 1/2"), dial type: to ANSI/ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.
  - .1 Acceptable materials:
    - .1 Winters
    - .2 Trerice
    - .3 Wiess
  - .2 Provide:
    - .1 Siphon for steam service.
    - .2 Snubber for pulsating operation.
    - .3 Diaphragm assembly for corrosive service.
    - .4 Gasketed pressure relief back with solid front.
    - .5 Bronze stop cock.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

### **3.2 THERMOMETERS**

- .1 Install in wells on all piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
  - .1 Water heaters/DHW boilers inlet and outlet.
  - .2 All ports of thermostatic mixing valve.
  - .3 In other locations indicated.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

### **3.3 PRESSURE GAUGES**

- .1 Install in following locations:
  - .1 Suction and discharge of pumps.
  - .2 Upstream and downstream of PRV's.

- .3 Upstream and downstream of control valves.
- .4 Inlet and outlet of coils.
- .5 Inlet and outlet of liquid side of heat exchangers.
- .6 Outlet of boilers.
- .7 Inlet and outlet of backflow preventors.
- .8 Upstream & downstream of water meters.
- .9 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

### **3.4 NAMEPLATES**

- .1 Install engraved lamicoid nameplates as specified elsewhere identifying medium.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American Society for Testing and Materials
  - .1 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A105/A105M, Specification for Carbon Steel Forgings for Piping Applications.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Indicate for each item as applicable:
  - .1 Manufacturer, model number, line contents, pressure and temperature rating.
  - .2 Movement handled; axial, lateral, angular and the amounts of each.
  - .3 Nominal size and dimensions including details of construction and assembly.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit maintenance data in accordance with general requirements.
- .2 Data to include:
  - .1 Servicing requirements, including any special requirements, stuffing box packing, lubrication and recommended procedures.

**Part 2 Products**

**2.1 FLEXIBLE CONNECTION**

- .1 Application: to suit motion.
- .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
- .3 Inner hose: stainless steel corrugated.
- .4 Braided wire mesh stainless steel outer jacket.
- .5 Diameter and type of end connection: as indicated.
- .6 Operating conditions:
  - .1 Working pressure: 1034 kPa (150 psi).
  - .2 Working temperature: 250°C (482°F).
  - .3 To match system requirements.



## **2.2 ANCHORS AND GUIDES**

- .1 Anchors:
  - .1 Provide as indicated.
- .2 Alignment guides:
  - .1 Provide as indicated.
  - .2 To accommodate specified thickness of insulation.
  - .3 Vapour barriers, jackets to remain uninterrupted.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install expansion joints with cold setting, as indicated as instructed by Consultant. Make record of cold settings.
- .2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

### **3.2 APPLICATION**

- .1 Provide on all vibration isolated equipment.
- .2 Provide where requested by equipment manufacturers installation manuals.
- .3 Install in accordance with manufacturer's recommendations.

### **3.3 THERMAL EXPANSION**

- .1 Provide in long runs of hot water mains exceeding 100 ft. in length.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .3 American Society for Testing and Materials (ASTM)
  - .1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture Selection, Application, and Installation.

**1.2 DESIGN REQUIREMENTS**

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Submit shop drawings and product data for following items:
  - .1 All bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.

**1.4 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

**Part 2 Products**

**2.1 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

**2.2 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: to ANSI & ULC requirements
  - .2 Ensure steel hangers in contact with copper piping are copper plated.
- .2 Upper attachment structural: Suspension from upper flange of I-Beam or joist.
  - .1 Cold piping NPS 50 mm (2") maximum: Ductile iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
    - .1 Rod: 10 mm (3/8") UL listed
  - .2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed & FM approved.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
  - .1 Cold piping NPS 50 mm (2") maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
  - .2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nuts.
- .4 Shop and field-fabricated assemblies.
  - .1 Trapeze hanger assemblies: ASME B31.1.
  - .2 Steel brackets: ASME B31.1.
- .5 Hanger rods: threaded rod material to MSS SP-58.
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .6 Pipe attachments: material to MSS SP-58.
  - .1 Attachments for steel piping: carbon steel.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for all piping.
  - .4 Oversize pipe hangers and supports to accommodate thermal insulation. Provide 1.5 mm (16 gauge) saddles.

- .7 Adjustable clevis: material to MSS SP-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

- .1 Ensure "U" has hole in bottom for rivetting to insulation shields.

## **2.3 RISER CLAMPS**

- .1 Steel or cast iron pipe: black carbon steel to MSS-SP-58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

## **2.4 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>2</sup> (13.12 lbs/ft<sup>2</sup>) density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m (10') span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm (12") long, with edges turned up, welded-in centre plate for pipe sizes NPS 300 mm (12") and over, carbon steel to comply with MSS SP-58.

## **2.5 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of miscellaneous metals, specified herein. Submit calculations with shop drawings.

## **2.6 OTHER EQUIPMENT SUPPORTS**

- .1 From structural grade steel meeting requirements of structural steel section specified herein.
- .2 Submit structural calculations with shop drawings.

## **2.7 MANUFACTURER**

- .1 Acceptable materials:
  - .1 Grinnell
  - .2 Anvil
  - .3 Myatt
  - .4 Taylor

### Part 3 Execution

#### 3.1 INSTALLATION

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to be to industry standards.
  - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: Install below joint.
- .3 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

#### 3.2 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.
- .2 Copper piping: up to NPS 15 mm (1/2"): every 1.5 m (5').
- .3 Within 300 mm (12") of each elbow and:

Maximum Pipe Size: NPS	Spacing Steel	Maximum Spacing Copper
up to 32 mm (1 1/4")	2.1 m (7')	1.8 m (6')
40 mm (1 1/2")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2 1/2")	3.6 m (12')	3.0 m (10')
80 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3 1/2")	3.9 m (13')	3.3 m (11')
100 mm (4")	4.2 m (14')	3.6 m (12')
125 mm (5")	4.8 m (16')	
150 mm (6")	5.1 m (17')	

#### 3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

- .4 Do "NOT" support piping, ductwork and equipment from roof deck, on bottom chord of floor and/or roof joist and/or from OWSJ bridging. Provide structural member between joist.

### **3.4 HORIZONTAL MOVEMENT**

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4mm (5/32") from vertical.
- .2 Where horizontal pipe movement is less than 15 mm (1/2"), offset pipe hanger and support so that rod hanger is vertical in the hot position.

### **3.5 FINAL ADJUSTMENT**

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

**END OF SECTION**

**Part 1 General**

**1.1 APPLICATION**

- .1 Seismic restraint is required for all systems and equipment in this building.

**1.2 SECTION INCLUDES**

- .1 Seismic Requirements for single rod hanger support for conduit, pipe and other similar systems.
- .2 Seismic Requirements for trapeze type supports for cable tray, conduit, pipe and other similar systems.
- .3 Seismic requirements for all plumbing equipment and piping.

**1.3 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Vibration Isolation Measures.

**1.4 REFERENCE STANDARDS**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 National Building Code of Canada (NBC).
- .3 Canadian Standards Association
  - .1 CSA S832, Seismic Risk Reduction of Operation and Functional Components (OFCs) of Buildings.
  - .2 CAN/CSA-S16.1 Limit States Design of Steel Structures
  - .3 CAN3-S136 Design of Cold Steel Structural Members
  - .4 CSA W47.1 Certification of Companies for Fusion Welding of Steel
  - .5 CSA W59 Welded Steel Construction
- .4 American Society of Testing and Materials
  - .1 ASTM A653/S653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (galvannealed) by the Hot Dip Process.
  - .2 ASTM A879M Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
  - .3 ASTM A307 Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .4 ASTM A325M Specification for Structural Bolts, Heat Treated 830MPa Minimum Tensile Strength.
- .5 All local codes.

- .6 FEMA: Seismic Restraint Installation Manuals 412. 413. & 414
  - .1 FEMA 412: Installing Seismic Restraints for Plumbing/Mechanical Equipment
  - .2 FEMA 413: Installing Seismic Restraints for Electrical Equipment
  - .3 FEMA 414: Installing Seismic Restraints for Duct and Pipe
- .7 ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.).
- .8 ASHRAE Applications Handbook; Seismic and Wind Restraint Design Chapter.

## 1.5 DEFINITIONS

- .1  $A_v$ : Effective peak velocity related acceleration coefficient BOCA, SBC Code.
- .2  $S_1$ : Mapped Long Period Seismic Acceleration Coefficient IBC, TI-809-04, ASCE7.
- .3  $S_s$ : Mapped Short Period Seismic Acceleration Coefficient IBC, TI-809-04, ASCE7.
- .4  $v$ : Zonal Velocity Coefficient NBC-Canada.
- .5 VISCMA: The Vibration Isolation and Seismic Control Manufacturers Association has developed Testing and Rating Standards for Seismic Restraint Components that comply with Code and ASHRAE based requirements.
- .6 VISCMA 102-2007: Static Qualification Standards for Obtaining a VISCMA Compliant Seismic Component Rating.
- .7  $Z$ : Seismic Zone defines Seismic Coefficient  $C_a$  used by UBC Code.

## 1.6 PERFORMANCE REQUIREMENTS

- .1 Design Ground Acceleration Coefficient ( $A_v$ ,  $S_s$ ,  $v$ , or  $Z$  depending on Code = X.XX).
- .2 (If IBC or TI-809-04) Design Long Period Ground Acceleration Coefficient ( $S_1$  = X.XX).
- .3 Design Soil Type = ( $S_a$ ,  $S_b$ ,  $S_c$ ,  $S_d$ ) as appropriate. (If NBC Canada, the Foundation Factor).
- .4 Importance or Performance Factor appropriate to structure =  $I_p$  = X.XX.
- .5 If UBC Zone 4, Proximity to Fault and, if less than 10km, Fault Type.
- .6 Schedule or drawings indicating critical ( $I_p$  = 1.5) Duct/Piping systems, including systems whose importance factor may be increased by proximity to critical components.

## 1.7 DESCRIPTION OF SYSTEM

- .1 It shall be understood that the requirements of this seismic restraint section are in addition to other requirements as specified elsewhere for the support and attachment of equipment and plumbing services, and for the vibration isolation of same equipment. Nothing on the project drawings or specifications shall be interpreted as justification to waive the requirements of this seismic restraint section.
- .2 The work under this section shall include furnishing all labour, materials, tools, appliances, and equipment, and performing all operations necessary for the complete execution of the installation of seismic snubber restraint assemblies as shown, detailed, and/or scheduled on the drawing and/or specified in this section of the specifications.



- .3 All seismic snubber restraint assemblies shall meet the following minimum requirements:
  - .1 The snubber/restrained isolator for isolated equipment shall include a resilient element that will ensure that no un-cushioned shock can occur (this does not include cable restraints).
  - .2 It shall be possible to visually inspect the resilient material for damage and allow for replacement, if necessary.
  - .3 All snubbers are to include a maximum air gap of 0.25 in (6 mm).
  - .4 Seismic restraint systems shall be designed to offer seismic restraint in all directions, unless otherwise noted.
  - .5 Seismic restraint capacities to be verified by an independent test laboratory or certified by a registered Professional Engineer to ensure that the design intent of this specification is realized. Verification shall be by one of the following methods:
    - .1 An NRTL (National Recognized Testing Laboratory), or laboratory recommended by VISCMA.
    - .2 Certified by a Professional Engineer with at least 5 years of experience, using industry standard methods of analysis, which employ common engineering practices. Adherence to the ratings standard within ASHRAE SPC171 and VISCMA 102-2007 is required.
    - .3 By a nationally recognized agency, such as VISCMA, that has reviewed and approved the restraint.

## **1.8 SYSTEM DESIGN**

- .1 Seismic restraint manufacturer shall be responsible for the structural design of attachment hardware as required to attach snubbers/restraints to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.
- .2 The contractor shall furnish, to the seismic restraint manufacturer, a complete set of approved shop drawings of all equipment that is to be restrained, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings furnished shall include, at a minimum, basic equipment layout, length, and width dimensions, and installed operating weights of the equipment to be restrained.
- .3 All piping, ductwork and equipment is to be restrained to meet code requirements. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various restraint sizes and anchors, as well as “worst case” reaction loads for each restraint and/or anchor size.
- .4 The contractor shall ensure that all housekeeping pads used are adequately reinforced and are properly dowelled to the building structure, so as to withstand calculated seismic forces. In addition, the size of the housekeeping pad is to be coordinated with the seismic restraint manufacturer to ensure that adequate edge distances exist in order to obtain the desired equipment anchor capacities.

**1.9 SEISMIC BRACING AND SUPPORT DESIGN REQUIREMENTS**

- .1 Seismic restraint designer shall coordinate all attachments with the structural engineer of record.
- .2 Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
- .3 Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
- .4 All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in Section 3.01.
- .5 Friction from gravity loads shall not be considered resistance to seismic forces.
- .6 Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14. Sway bracing used for seismic restraint purposes must be fitted with provisions to resist the vertical force component of the diagonal brace. Single diagonal brace for seismic restraint will not be approved.

**1.10 QUALITY ASSURANCE**

- .1 The contractor shall provide pre-engineered seismic restraint systems to meet total design lateral force requirements for support and restraint of piping, conduit, cable trays and other similar systems and equipment where required by the applicable building code.
- .2 System Supports/Restraints: Firms regularly engaged in the manufacture of products of the types specified in this section, whose products have been in satisfactory use in similar service for not less than 5 years.
- .3 Bolted framing channels and fittings shall have the manufacturers name, part number, and material heat code identification number stamped in the part itself for identification. Material certification sheets and test reports must be made available by the manufacturer upon request.
- .4 Only companies experienced in performing the work of this section shall do the installation.
- .5 All seismic restraint installations shall be independently reviewed by the Owners Representative for compliance with project specifications.

**1.11 SUBMITTALS**

- .1 Product Data: Include Seismic Rating Curve for each seismically rated isolator or restraint component.
- .2 Samples: The contractor shall submit samples of specified seismic snubber devices for approval.

- .3 Shop Drawings shall include the following:
  - .1 Design Calculations: Calculate requirements for selecting seismically rated vibration isolators and seismic restraints. Certification documents to be signed and sealed by a qualified Professional Engineer with at least 5 years of experience in the design of seismic restraints. Professional engineer shall have local jurisdiction and provide periodic field review and final certification upon completion of the project. All costs and fees associated with the engineering shall be the responsibility of this contractor.
  - .2 Vibration Isolation Bases: Dimensional drawings including anchorage and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads.
  - .3 Seismic-Restraint Details: Detailed submittal drawings of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors. Include ratings for loads.
  - .4 Equipment Manufacturer Seismic Qualification Certification: The Equipment Manufacturer must submit certification that each piece of provided equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
    - .1 Basis for Certification: Indicate whether the "withstand" certification is based on actual test assembled components or on calculations.
    - .2 Indicate the equipment is certified to be durable enough to:
      - .1 structurally resist the design forces and/or
      - .2 will remain functional after the seismic event.
  - .5 Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - .6 Detailed description of the assumed equipment anchorage devices on which the certification is based.

#### **1.12 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver strut systems, pipe hangers and components carefully to avoid breakage, denting, and scoring finishes. Do not install damaged equipment.
- .2 Store strut systems, pipe hangers and components in original cartons and in clean dry space; protect from weather and construction traffic.

#### **1.13 WORK FURNISHED BUT NOT INSTALLED**

- .1 The materials and systems specified in this section shall be purchased by the plumbing contractor from a single seismic snubber restraint materials manufacturer to assure sole source responsibility for the performance of the seismic restraints used.
- .2 The materials and systems specified in this section can, at the contractor's option, be installed by the subcontractor who installs the seismic restraint systems.

**1.14 COORDINATION**

- .1 Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting seismically rated equipment. Concrete shall have a minimum compressive strength of 3,000 psi or as specified by the consultant.
- .2 Coordinate with seismic restraint manufacturer to locate and size structural supports underneath seismically restrained equipment (e.g. roof curbs, cooling towers, and other similar equipment).

**1.15 INSTALLATION**

- .1 Installation of all seismic restraint materials specified herein shall be accomplished following the manufacturer's written instructions. Installation instructions shall be submitted to the engineer for approval prior to the beginning of the work.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Unless otherwise specified materials used in the Work shall conform to the following:
  - .1 All steel rolled sections and steel plates shall conform to CAN/CSA G40.21M-300W
  - .2 All steel hollow structural steel sections shall conform to CAN/CSA G40.21-350W Class C
  - .3 Structural steel bolts, nuts and washers shall conform to ASTM A325M
  - .4 Weld electrodes shall be SMAW-E-E480XX and SAW-F480-EXXX.

**2.2 ACCEPTABLE MANUFACTURERS**

- .1 All seismic snubbers and combination restraint/vibration isolation materials specified herein shall be provided by a single manufacturer to assure sole source responsibility for the proper performance of the materials used. Manufacturer is to be a member of VISCMA.
- .2 Anchor types and sizes are to be per the design data as provided by the seismic restraint manufacturer.
- .3 Materials and systems specified herein and detailed or scheduled on the drawings are based upon materials manufactured by Kinetics Noise Control Inc. Materials and systems provided by other manufacturers are acceptable, provided that they meet all requirements as listed in this specification.
- .4 Kinetics Noise Control Inc.
- .5 Cooper 'B' Line.
- .6 Unistrut Building Systems.
- .7 Mason Industries.

## 2.3 SEISMIC SNUBBER TYPES

### GENERAL

(Isolator/Snubber Types contained herein are per ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) Handbook, HVAC Applications, Seismic and Wind Restraint Design)

- .1 Type A, Coil Spring Isolator Incorporated Within a Ductile Iron or Cast Aluminum Housing.
  - .1 Cast iron or aluminum housings are brittle when subjected to shock loading and are therefore not approved for seismic restraint applications.
- .2 Type B, Coil Spring Isolator Incorporated Within A Steel Housing
  - .1 Spring isolators shall be seismic control restrained spring isolators, incorporating a single or multiple coil spring element, having all of the characteristics of free standing coil spring isolators as specified in the vibration isolation portion of this specification. Springs shall be restrained using a housing engineered to limit both lateral and vertical movement of the supported equipment during an earthquake without degrading the vibration isolation capabilities of the spring during normal equipment operating conditions.
  - .2 Vibration isolators shall incorporate a steel housing and neoprene snubbing grommet system designed to limit motion to no more than ¼" (6 mm) in any direction and to prevent any direct metal-to-metal contact between the supported member and the fixed restraint housing. The restraining system shall be designed to withstand the seismic design forces in any lateral or vertical direction without yield or failure. Where the capacity of the anchorage hardware in concrete is inadequate for the required seismic loadings, a steel adapter base plate to allow the addition of more or larger anchors will be fitted to fulfill these requirements. In addition to the primary isolation coil spring, the load path will include a minimum ¼" (6 mm) thick neoprene pad.
  - .3 Spring elements shall be colour coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000-hour rating when tested in accordance with ASTM B-117.
  - .4 . To facilitate servicing, the isolator will be designed in such a way that the coil spring element can be removed without the requirements to lift or otherwise disturb the supported equipment.
  - .5 Spring isolators shall be Model FHS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (2).

- .3 Type C, Coil Spring Isolator Incorporated Within a Steel Housing
  - .1 Spring isolators shall be seismic control restrained spring isolators, incorporating one or more coil spring elements, having all the characteristics of free standing coil spring isolators per the vibration isolation section of this specification, for equipment which is subject to load variations and/or large external forces. Isolators shall consist of one or more laterally stable steel coil springs assembled into fabricated welded steel housings designed to limit movement of the supported equipment in all directions.
  - .2 Housing assembly shall be made of fabricated steel members and shall consist of a top load plate complete with adjusting and leveling bolts, adjustable vertical restraints, isolation washers, and a bottom load plate with internal non-skid isolation pads and holes for anchoring the housing to the supporting structure. Housing shall be hot dipped galvanized for outdoor corrosion resistance. Housing shall be designed to provide a constant free and operating height within  $\frac{1}{8}$ " (3 mm).
  - .3 The isolator housing shall be designed to withstand the project design seismic forces in all directions.
  - .4 Coil spring elements shall be selected to provide static deflections as shown on the vibration isolation schedule or as indicated or required in the project documents. Spring elements shall be colour coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000-hour rating when tested in accordance with ASTM B-117.
  - .5 Spring isolators shall be Model FLS and FLSS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (3).
- .4 Type D, Coil Spring Isolator Incorporated with Integral Seismic Restraint
  - .1 Spring isolators shall be single or multiple coil spring elements which have all of the characteristics of freestanding coil spring isolators as specified in the vibration isolation portion of this specification, incorporating lateral and vertically restrained seismic housing assemblies. Spring elements shall be readily replaceable without the need to list or remove the supported equipment.
  - .2 Restraint housing shall be sized to meet or exceed the force requirements of the application and shall have the capability of accepting coil springs of various sizes, capabilities, and deflections as required to meet the required isolation criteria. All spring forces shall be contained within the coil/housing assembly, and the restraint anchoring hardware shall not be exposed to spring generated forces under conditions of no seismic force. Spring element leveling adjustment shall be accessible from above and suitable for use with a conventional pneumatic or electric impact wrench.

- .3 Restraint element shall incorporate a steel housing with elastomeric elements at all dynamic contact points. Elastomeric elements shall be replaceable. Restraint shall allow  $\frac{1}{4}$ " (6 mm) free motion in any direction from the neutral position. Restraint shall have an overturning factor (ratio of effective lateral snubber height to short axis anchor spacing) of 0.33 or less to ensure optimum anchorage capacity.
- .4 Spring isolators shall be Model FMS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (4).
- .5 Type E, All Direction Neoprene Isolator
  - .1 Vibration Isolators shall be neoprene, molded from oil resistant compounds, designed to operate within the strain limits of the isolator so to provide the maximum isolation and longest life expectancy possible using neoprene compounds. Isolators shall include encapsulated cast-in-place top steel load transfer plate for bolting to equipment and a steel base plate with anchor holes for bolting to the supporting structure. Ductile iron or cast aluminum components are not acceptable alternatives and shall not be used due to brittleness when subjected to shock loading.
  - .2 Isolator shall be capable of withstanding the design seismic loads in all directions with no metal-to-metal contact.
  - .3 Isolator shall have minimum operating static deflections as shown on the project Vibration Isolation Schedule or as otherwise indicated in the project documents and shall not exceed published load capacities.
  - .4 Neoprene isolators shall be Model RQ as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections .2.01, 2.02 and 2.03 (5).
- .6 Type F, Light Capacity All Direction 3-Axis External Seismic Snubber Assembly
  - .1 Equipment shall be restrained against excessive movement during a seismic event by the use of 3-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all three directions, and additional snubbers shall be used as required by seismic design conditions.
  - .2 Snubbers shall be of interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of  $\frac{1}{4}$ " (6 mm) in any direction.
  - .3 Snubbers shall include a minimum  $\frac{1}{4}$ " (6 mm) thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Maximum neoprene bearing pressure shall not exceed 1500 pounds / sq. inch (10.4 N / sq. mm). Snubber shall be capable of withstanding an externally applied seismic force of up to 3,000 pounds (1360 kg) in any direction. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.

- .4 Three-axis seismic snubbers shall be Model HS-5 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and 2.01, 2.02, and 2.03 (6).
- .7 Type G, Lateral 2-Axis External Seismic Snubber Assembly
  - .1 Equipment shall be restrained against excessive lateral movement during a seismic event by the use of 2-axis horizontal resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all horizontal directions, and additional snubbers shall be used as required by seismic design conditions.
  - .2 Snubbers shall be interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location to a maximum of ¼" (6 mm).
  - .3 Snubbers shall include a minimum of ¼" (6 mm) thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.
  - .4 Two-axis lateral seismic snubbers shall be Model HS-2 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (7).
- .8 Type H, Heavy Capacity All Direction 3-Axis External Seismic Snubber Assembly
  - .1 Equipment shall be restrained against excessive vertical and horizontal movement during a seismic event by the use of 3-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all three directions, and additional snubbers shall be used as required by seismic design conditions.
  - .2 Snubbers shall be of welded interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of ¼" (6 mm) in any direction.
  - .3 Snubbers shall include resilient neoprene pads with a minimum thickness of ¼" (6 mm) to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be capable of withstanding an externally applied seismic force up to 10,000 pounds (4,540 kg) in any direction. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.
  - .4 Three-axis seismic snubbers shall be Model HS-7 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (8).



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- .9 Type I, Horizontal 1-Axis External Seismic Snubber Assembly
- .1 Equipment shall be restrained against excessive horizontal one-axis movement during a seismic event by the use of single-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of four (4) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all lateral directions.
  - .2 Snubbers shall be of steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location in the direction of impact to a maximum of ¼" (6 mm).
  - .3 Snubbers shall include resilient neoprene pads with a minimum thickness of ¼" (6 mm) to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to eliminate any contact during normal equipment operation.
  - .4 Single-axis seismic snubbers shall be Model HS-1 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (9).
- .10 Type J, Cable Restraints for Suspended Piping and Ductwork
- .1 Seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist project seismic loads, arranged to offer seismic restraint capabilities for piping, ductwork, and suspended equipment in all lateral directions.
  - .2 Building and equipment attachment brackets at each end of the cable shall be designed to permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points as required to eliminate potential for dynamic cable wear and strand breakage.
  - .3 Restraints shall be sized to the capacity of the cable or to the capacity of the anchorage, whichever is lesser.
  - .4 Seismic wire rope connections shall be made using overlap wire rope "U" clips or seismically rated tool-less wedge insert lock connectors.
  - .5 Vertical suspension rods shall be braced as required to avoid potential for buckling due to vertical "up" forces. Braces shall be structural steel angle uniquely selected to be of sufficient strength to prevent support rod bending. Brace shall be attached to the vertical suspension rod by a series of adjustable straps. Clips shall be capable of securely locking brace to suspension rod without the need for hand tools.
  - .6 Where clevis hanger brackets are used for seismic restraint attachment, they will be fitted with clevis internal braces to prevent buckling of the hanger brackets.
  - .7 Seismic cable shall be as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.03 through 1.07 inclusive, and sections 2.01, 2.02, and 2.03 (10).

- .8 Seismic cable building and equipment attachment brackets shall be Model KSCA, KSCU, or KSCC as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .9 Seismic cable concrete anchor bolts shall be Model KCAB Wedge, Model KCCAB Cracked Concrete, or Model KUAB Undercut, as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .10 Seismic wire rope connectors shall be (Model KWRC - 'U' clamp) / (Model KWGC - Tool-less wedge lock) as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .11 Seismic vertical suspension stiffener rod clips shall be Model KHRC as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .12 Clevis Internal Braces shall be Model KCHB as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).

## **2.4 SEISMIC BRACING COMPONENTS**

- .1 Steel strut shall be 1-5/8 wide in varying heights and mig-welded combinations as required to meet load capacities and designs. A material heat code, part number, and manufacturer's name shall be stamped on all strut and fittings to maintain traceability to material test reports.
- .2 Material for epoxy painted strut: ASTM A1011, SS, Grade 33.
- .3 Material for pre-galvanized strut: ASTM A653, SS, Grade 33.
- .4 Material for hot-dip galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.
- .5 Material for fittings and accessories: ASTM A907, Grade 33, Structural Quality or ASTM A1011, SS, Grade 33.
- .6 Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

## **2.5 UNIFORM BUILDING CODE REQUIREMENTS**

- .1 Seismic Zone Factor to Table 16-I for area of jurisdiction.
- .2 Soil Profile Type to Table 16-J for area of jurisdiction.
- .3 Seismic Importance Factor to Table 16-K for area of jurisdiction.
- .4 Component Amplification Factor to Table 16-O for area of jurisdiction.
- .5 Component Response Mod. Factor to Table 16-O for area of jurisdiction.
- .6 Seismic Coefficient to Table 16-Q for area of jurisdiction.

- .7 The total height of the structure ( $h_s$ ) and the height of the system to be restrained within the structure ( $h_r$ ) shall be determined in coordination with architectural plans and the General Contractor.
- .8 Forces shall be calculated for individual supports using the above information. Exceptions to Table 16-O may be utilized. However, all use of exceptions shall be noted on submitted seismic bracing plan documents.

### **Part 3 Execution**

#### **3.1 GENERAL INSTALLATION**

- .1 Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions.
- .2 Refer to FEMA Manuals 412, 413, and 414 for typical industry standard installation guidelines.
- .3 Upon completion of installation of all seismic restraint materials and before start-up of restrained equipment, all debris shall be cleaned from beneath all protected equipment, leaving equipment free to contact snubbers/restraints.
- .4 Torque anchor bolts according to anchor manufacturer's written instructions to resist seismic forces.
- .5 All seismic restraint systems shall be installed in strict accordance with the manufacturer's seismic restraint guidelines manual and all certified submittal data.
- .6 Prior to installation, bring to the architect's/engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- .7 Brace support rods when necessary to accept compressive loads. Welding of compressive braces to the vertical support rods is not acceptable.
- .8 Seismic restraints shall be attached to the structural system. Looping restraints around the system is not acceptable.
- .9 Do not brace a system to two independent structures such as ceiling and wall.
- .10 Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- .11 Seismic restraint cables shall be adjusted such that they are not visibly slack, or the flexibility is approximately 25mm under thumb pressure for a 1500mm cable length (equivalent ratio for other cable lengths).
- .12 All seismic restraint cables shall be at least 25mm clear of all other equipment and services.

### **3.2 EQUIPMENT INSTALLATION**

- .1 All external utility connections to restrained equipment shall be designed to allow differential seismic motion without damage to the equipment or utility connections.
- .2 Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following the manufacturer's written instructions.
- .3 After equipment installation is completed, adjust limit stops following manufacturer's written instructions so that they are out of contact during normal operation.
- .4 Adjust snubbers according to manufacturer's written instructions.
- .5 Installation of seismic restraints shall not cause any change in position of equipment, resulting in stresses or misalignment.
- .6 No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration isolation system specified.
- .7 Do not install any seismic restraint for equipment, cable trays or conduit that compromises isolation specified.

### **3.3 PIPING INSTALLATION**

- .1 Hold down clamps must be used to attach pipe to all trapeze members before applying restraints.
- .2 Branch lines may not be used to restrain main lines.
- .3 Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent piping.
- .4 Attach piping to the trapeze per seismic restraint manufacturer's design. Install cables so they do not bend across sharp edges of adjacent equipment or building structures.

### **3.4 FASTENING TO STRUCTURE**

- .1 Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or wedge-type concrete anchors. Consult structural engineer of record.
- .2 Overstressing of the building structure shall not occur from overhead support of equipment. Bracing attached to structural members may present additional stresses. The contractor shall submit loads to the structural engineer of record for approval in this event.
- .3 Coring is not permitted for the installation of concrete anchors. Use ground penetrating radar or equivalent method of embedment item detection to locate all embed items including reinforcing steel and electrical conduits. Concrete reinforcing steel and electrical conduits shall not be cut or damaged under any circumstances.
- .4 Install vertical braces to stiffen hanger rods and prevent buckling per seismic restraint manufacturer's design. Clamp vertical brace to hanger rods. Requirements apply equally to hanging equipment. Do not weld vertical braces to hanger rods.

- .5 If mounting hole diameter exceeds bolt diameter by more than 0.125" (3 mm), reduce clearance in hole with epoxy grout, flanged elastomeric bushings or welded washer.
- .6 Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors. Refer to seismic restraint manufacturer's written instructions.

### **3.5 INSPECTION**

- .1 The contractor shall notify the local representative of the seismic restraint materials manufacturer prior to installing any seismic restraint devices. The contractor shall seek the representative's guidance in any installation procedures with which he/she is unfamiliar.
  - .2 Upon completion of the installation of all seismic restraint devices herein specified, the local representative of the seismic restraint manufacturer shall, at the contractor's request, inspect the completed system and report in writing any installation errors, improperly selected snubber devices, or other fault in the system which could affect the performance of the system.
  - .3 The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.
- .1 Guidelines for Mechanical Systems", Second Edition (Remaining Codes).

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Provide separate shop drawings for each isolated system complete with performance and product data.

**Part 2 Products**

**2.1 GENERAL**

- .1 Size and shape of bases type and performance of vibration isolation to be as indicated.
- .2 To be of the same manufacturer for all isolation.
- .3 Acceptable materials:
  - .1 Korfund
  - .2 Vibro-Acoustics
  - .3 Vibron

**2.2 ELASTOMERIC PADS**

- .1 Type EP1 - neoprene waffle or ribbed; 10 mm (3/8") minimum thick; 50 durometer; maximum loading 350 kPa (50.8 psi).
- .2 Type EP2 - rubber waffle or ribbed; 10 mm (3/8") minimum thick; 30 durometer natural rubber; maximum loading 415 kPa (60.2 psi).
- .3 Type EP3 - neoprene-steel-neoprene; 10 mm (3/8") minimum thick neoprene bonded to 1.5 mm (16 gauge) steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa (50.8 psi).
- .4 Type EP4 - rubber-steel-rubber; 10 mm (3/8") minimum thick rubber bonded to 1.5 mm (16 gauge) steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa (60.2 psi).
- .5 Acceptable materials:
  - .1 Korfund
  - .2 IAC Acoustics
  - .3 Vibro-Acoustics
  - .4 Vibron

**2.3 ELASTOMERIC MOUNTS**

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of [60]; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

- .2 Acceptable materials:
  - .1 Vibro-Acoustics
  - .2 Korfund
  - .3 IAC Acoustics
  - .4 Vibron

## **2.4 SPRINGS**

- .1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.
- .3 Cadmium plate for all installations.
- .4 Colour code springs.

## **2.5 SPRING MOUNT**

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; leveling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg (2100 lbs) maximum.
- .6 Performance: as indicated.
- .7 Acceptable materials:
  - .1 Korfund
  - .2 IAC Acoustics
  - .3 Vibron
  - .4 Vibro-Acoustics

## **2.6 HANGERS**

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, molded with rod isolation bushing, which passes through hanger box.
- .3 Performance as indicated.

- .4 Acceptable materials:
  - .1 Vibron
  - .2 IAC Acoustics
  - .3 Korfund
  - .4 Vibro-Acoustics

## **2.7 HORIZONTAL THRUST RESTRAINT**

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 10 mm (3/8").
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.
- .3 Acceptable materials:
  - .1 Korfund
  - .2 IAC Acoustics
  - .3 Vibron
  - .4 Vibro-Acoustics

## **2.8 STRUCTURAL BASES**

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm (96") on smallest dimension, split for field welding on sizes over 2400 mm (96") on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm (1") minimum.
- .4 Acceptable materials:
  - .1 Korfund
  - .2 IAC Acoustics
  - .3 Vibron
  - .4 Vibro-Acoustics

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.



- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm (1") minimum static deflection as follows:
  - .1 Up to NPS 100 mm (4"): first 3 points of support. NPS 125 mm (5") to NPS 200 mm (8"): first 4 points of support. NPS 250 mm (10") and Over: first 6 points of support.
  - .2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm (2").
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

### **3.2 SITE VISIT**

- .1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Consultant.
- .2 Provide Consultant with notice 24 h in advance of visit.
- .3 Make adjustments and corrections in accordance with written report.

### **3.3 TESTING**

- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Testing Adjusting and Balancing Section.
- .2 Vibration measurements shall be taken for equipment-listed below:
- .3 Provide Consultant with notice 48 h in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations including sound curves.
- .5 Submit complete report of test results including sound curves.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 Canadian Standards Association (CSA).
  - .1 Natural Gas and Propane Installation Code CSA B149.1.
- .4 National Fire Protection Association
  - .1 NFPA 13, Installation of Sprinkler Systems.
  - .2 NFPA 14, Standpipe and Systems.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with General Requirements.
- .2 Product data to include paint colour chips, all other products specified in this section.

**1.3 PRODUCT LITERATURE**

- .1 Submit product literature in accordance with General Requirements.
- .2 Product literature to include nameplates, labels, tags, lists of proposed legends.

**Part 2 Products**

**2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Metal or plastic lamicoid nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

**2.2 SYSTEM NAMEPLATES**

- .1 Colours:
  - .1 Black letters, white background (except where required otherwise by applicable codes).

- .2 Construction:
- .1 3 mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
- .1 Conform to following table:
- | Size | No. of<br>Sizes mm (") | Height of<br>Line mm (") | Letters mm (") |
|------|------------------------|--------------------------|----------------|
| 1    | 10 x 50 (3/8" x 2")    | 1 (3/64")                | 3 (1/8")       |
| 2    | 15 x 75 (1/2" x 3")    | 1 (3/64")                | 6 (1/4")       |
| 3    | 15 x 75 (1/2" x 3")    | 2 (5/64")                | 3 (1/8")       |
| 4    | 20 x 100 (3/4" x 4")   | 1 (3/64")                | 10 (3/8")      |
| 5    | 20 x 100 (3/4" x 4")   | 2 (6/64")                | 6 (1/4")       |
| 6    | 20 x 200 (3/4" x 8")   | 1 (3/64")                | 10 (3/8")      |
| 7    | 25 x 125 (1" x 5")     | 1 (3/64")                | 15 (1/2")      |
| 8    | 25 x 125 (1" x 5")     | 2 (5/64")                | 10 (3/8")      |
| 9    | 32 x 200 (1¼" x 8")    | 1 (3/64")                | 20 (3/4")      |
- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
- .1 Equipment in Mechanical Rooms: Use size #9.
- .2 Equipment above ceiling: use size #1 riveted to ceiling suspension system.

## 2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.

## 2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Legend:
- .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .3 Arrows showing direction of flow:
- .1 Outside diameter of pipe or insulation less than 75 mm (3"): 100 mm (4") long x 50 mm (2") high.
- .2 Outside diameter of pipe or insulation 75 mm (3") and greater: 150 mm (6") long x 50 mm (2") high.
- .3 Use double-headed arrows where flow is reversible.
- .4 Extent of background colour marking:
- .1 To full circumference of pipe or insulation.
- .2 Length to accommodate pictogram, full length of legend and arrows.

- .5 Materials for background colour marking, legend, arrows:
- .1 Pipes and tubing 20 mm (3/4") and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (395°F).
- .6 Colours and Legends:
- .1 Where not listed, obtain direction from Consultant.
  - .2 Colours for legends, arrows: To following table:
- |                    |         |         |
|--------------------|---------|---------|
| Background colour: | Legend: | Arrows: |
| Yellow             | White   | Black   |
| Green              | White   | Black   |
| Red                | White   | Black   |
- .7 Pictograms:
- .1 **Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.**
- .8 Background colour marking and legends for piping systems:

CONTENTS	BACKGROUND COLOUR MARKING	LEGEND
Continuous blow-off		CONT. BLOW-OFF
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HW recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Domestic tempered supply	Green	DOM. TEMPERED
Trap Primer	Green	TRAP PRIMER
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Comp air 700 kPa (101.6 psi)	Green	COMP. AIR [____] kPa (____psi)

## 2.5 VALVES, CONTROLLERS

- .1 Brass tags with 15 mm (1/2") stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

- .3 Provide adhesive coloured tab (max. size 15 mm) indication on ceiling to locate valves/equipment above. Same applies to grid. Colour to be approved by consultant.

## **2.6 LANGUAGE**

- .1 Identification to be in English.

## **Part 3 Execution**

### **3.1 TIMING**

- .1 Provide identification only after all painting specified has been completed.

### **3.2 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.

### **3.3 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection
  - .1 Do not paint, insulate or cover in any way.

### **3.4 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS**

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 m (5'-8") intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- .7 At beginning and end points of each run and at each piece of equipment in run.

- .8 Identification to be easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.5 VALVES, CONTROLLERS**

- .1 Valves and operating controllers, except at plumbing fixtures, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively. Where existing numbering system is installed start new numbering system at 100.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED DOCUMENTS**

- .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 REFERENCES**

- .1 Heating cable must conform to CSA 22.2 No.130-03 (latest edition).

**1.3 SUMMARY**

- .1 Section includes heat tracing for fire-suppression piping with self-regulating, parallel resistance.

**1.4 SUBMITTALS**

- .1 Product Data: For each type of product.
- .2 Include:
  - .1 Heating cable data sheet.
  - .2 Connection kits and accessories data sheet.
  - .3 Controller data sheet.
  - .4 Controller wiring diagram.
- .3 Include rated capacities, operating characteristics, and furnished specialties and accessories.
- .4 Schedule heating capacity, length of cable, and electrical power requirement for each electric heating cable required.
- .5 Include heat loss calculations for each pipe including pipe and insulation characteristics, heat loss, and watts per foot supplied by the heating cable.
- .6 Shop Drawings: For electric heating cable.
  - .1 Include plans, elevations, and sections.
  - .2 Include diagrams for power, signal, and control wiring.
  - .3 Manufacturer to produce detailed design as described below.
- .7 Design Submittal: Submit signed and sealed design layout drawings by the qualified professional engineer responsible for their preparation. Delegated design submittals include:
  - .1 Heat Trace Circuit Layout Drawings, including:
    - .1 Location/Identification of area to be traced.
    - .2 Heater circuit number.
    - .3 Electrical load.
    - .4 Heater catalog numbers.
    - .5 Heater termination points.

- .6 Start-up temperature.
  - .7 Location of all components.
  - .8 Material list and quantities of all components.
  - .9 Heating cable layout.
  - .10 Design parameters.
  - .11 Insulation type and thickness.
  - .12 Position of all components.
  - .13 Material schedule listing all components and quantities used.
  - .14 Panel ID number.
- .8 Minimum heat trace capacity shall be 8 watts per foot irrespective of heat loss calculation.
- .9 Pipe Freeze Protection Detail Drawings: Project-specific Detail Drawings, including details showing:
  - .1 Installation and positioning of all components.
  - .2 Proper amounts of tracing for valves, pumps, flanges, fittings, instruments, etc.
  - .3 Junction box layouts.
- .10 Control Panel Drawings: Drawings for each control panel shall include the following:
  - .1 Physical arrangement and detail drawings.
  - .2 Complete power and control wiring diagrams showing all internal wiring connections for electrical and instrument components in each control panel. All wires, terminals, and devices shall be numbered and tagged in accordance with system elementary diagrams.
- .11 System Wiring Diagram: Project-specific drawings including:
  - .1 Interconnect of all major components.
  - .2 Assignment of circuiting.
  - .3 Connection of circuit wiring in terminal blocks.
  - .4 Connection of sensor wiring.
  - .5 Connection of external alarm wiring.
- .12 Controller Setpoint Schedule showing the following:
  - .1 Circuit addresses.
  - .2 Circuit set points.
  - .3 **Circuit alarms and settings.**
- .13 Testing Instructions and Reporting Form: Provide documentation for use in preinstallation testing of heat-tracing system.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- .2 Testing: Completed system test report.



## **1.6 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications:
  - .1 ISO-09001 registered.
  - .2 Provide products consistent with UL 515A, CSA 22.2 No 130-16, and IEEE 515.1 requirements.
- .2 Installer Qualifications:
  - .1 System Installer to have complete understanding of product and product literature from manufacturer or authorized representative prior to installation.
  - .2 Electrical connections to be performed by licensed electrician.
- .3 Certification: System (Heating Cable and Connection Kits): c-UL-us Listed for freeze protection of standpipes, mains, and branch fire sprinkler piping.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying the following:
  - .1 Product and Manufacturer.
  - .2 Length/Quantity.
  - .3 Lot Number.
  - .4 Installation and operation Manual.
  - .5 Material Safety Data Sheet (MSDS).
- .2 Store heating cable in clean, dry location with a temperature range of -18° to 60 C (0 to 140 F).
- .3 Protect heating cable ends from moisture ingress until final termination of the heating cable is complete.

## **1.8 WARRANTY**

- .1 Manufacturer Limited Warranty: Manufacturer agrees to repair or replace heat tracing products listed below that fail in materials or workmanship within specified warranty period.
- .2 Covered Products Include:
  - .1 Heating cables, connection kits, and accessories.
  - .2 Thermostats, controllers, panels, contactors, sensors, and accessories.
- .3 Warranty Period: Two years from date of Ready for Takeover.
- .4 Manufacturer's Extended Warranty: Provide Owner an extended product warranty for heat-tracing products for a period of 10 years from date of Ready for Takeover.

## **Part 2            Products**

### **2.1                SYSTEM DESCRIPTION**

- .1      Complete pipe freeze protection system for insulated pipes exposed to the risk of freezing. System consists of a self-regulating heating cable, connection kits, accessories, and energy-efficient control and monitoring controller. The heating cable shall have a polyolefin jacket for aboveground fire sprinkler piping, including standpipes, mains, and branch fire sprinkler piping. The monitoring controller must be suitable for integration into the BAS.

### **2.2                PERFORMANCE REQUIREMENTS**

- .1      Manufacturer to design complete and functional heat-tracing system. Design must be signed and sealed by a professional engineer.

### **2.3                SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES (TYPE-1)**

- .1      Basis of design product: Raychem or nVent XL-Trace.
- .2      Comply with UL 515A, CSA 22.2 No 130-16, and IEEE 515.1 requirements.
- .3      Heating Element: Pair of parallel No. 16 AWG, nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Cable shall be capable of crossing over itself once without overheating.
- .4      Electrical Insulating Jacket: Flame-retardant modified polyolefin.
- .5      Ground Braid: Tinned-copper braid. Minimum 70 percent for ground path and mechanical ruggedness.
- .6      Outer Jacket: Modified polyolefin with ultraviolet inhibitor. Outer jacket to be printed with cable model number, agency listings, batch number, and meter marks (for ease of installation within maximum circuit length).
- .7      Maximum Operating Temperature (Power On): 68 C (154 F) for and **8 W/ft. (26 W/m)** or 12 W/ft was required to suit load.
- .8      Maximum Exposure Temperature (Power Off): 85 C (185 F).
- .9      Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- .10     Capacities and Characteristics:
  - .1      Nominal Heat Output at 10 C (50 F): 8 W/ft. (26° W/m) minimum. Provide higher as required based on heat loss calculations.
  - .2      Piping Diameter: Refer to plans.
  - .3      Electrical Characteristics for Single-Circuit Connection:
    - .1      Volts: 208
    - .2      Phase: Single.

## 2.4 SINGLE POINT DIGITAL CONTROLLER

- .1 Basis-of Design Product: RAYCHEM; 460.
- .2 Control self-regulating heating cable via an energy-saving, programmable single-circuit controller to provide adjustable maintained temperatures in the range of 0 to 80 C (32 to 176 F).
- .3 Contractor shall provide one (1) 460 controller for each heat tracing circuit as indicated on heat tracing schedule
- .4 Controller shall include a user defined self-test function to verify heat-tracing integrity daily, weekly or monthly.
- .5 Controller shall be able to use two temperature sensors per circuit with ability to assign any of them for high temperature cut-out function.
- .6 Controller shall include user-defined filters for temperature alarms to avoid nuisance alarms.
- .7 Controller shall have ground fault current sensing and relaying equipment that complies with UL1053 requirements. External ground fault devices are not allowed.
- .8 Controller shall have user-defined settings for ground fault alarm and trip levels.
- .9 Controller shall store at least 100 past events/alarms to aid maintenance
- .10 Controller Capabilities:
  - .1 Supply Voltage: 120 to 277 V ac.
  - .2 Enclosure: NEMA 12 (indoor use).
  - .3 Operating Temperature Range: 0 to 40 C (32 to 105 F).
  - .4 Display: 5" touchscreen color display.
  - .5 Control: DP mechanical relay type.
  - .6 Control Algorithms: Ambient On/Off. Line Sensing. Proportional Ambient Sensing Control (PASC) for energy savings.
  - .7 Monitoring:
    - .1 Temperature:
      - .1 Low Alarm: -40 to 88 C (40 to 190 F).
      - .2 High Alarm: 0 to 88 C (32 to 190 F).
    - .2 Ground Fault:
      - .1 Alarm Range: 20 to 200 mA.
      - .2 Trip Range: 20 to 200 mA
    - .3 Current:
      - .1 Low Alarm: Built-in 0.25 A.
    - .4 Autocycle Diagnostics: Built-in (Daily).
  - .8 Temperature Sensor Inputs:
    - .1 Quantity: Two.
    - .2 Type: Thermistor 2 K-Ohm / 25°C (77°F), 2-wire.

- .9 Alarm Outputs:
  - .1 AC Relay: Single pole double throw relay, volt-free; maximum switching capacity (resistive load only) 1 A/30 VDC, 0.5 A/125 VAC. Maximum 60 VDC/125 VAC.
  - .2 Outputs: Normally open or normally closed.
- .10 Stored Parameters:
  - .1 Time stamp.
  - .2 Warning.
  - .3 Event description.
  - .4 Device ID.
  - .5 Language.
  - .6 Country.
  - .7 Control mode.
  - .8 Cable type.
  - .9 Supply voltage.
  - .10 Sensor 1 and 2.
  - .11 Setpoint.
  - .12 Deadband.
  - .13 Minimum expected ambient temperature.
  - .14 Power adjustment.
  - .15 GFCI current.
  - .16 Load current.
  - .17 Board temperature.
- .11 Alarm Conditions:
  - .1 Low and high temperature.
  - .2 Low current.
  - .3 Ground fault alarm and trip.
  - .4 RTD failure.
  - .5 EMR failure.
- .12 Communications:
  - .1 Alarm relay to fire alarm panel
- .11 Temperature Sensors:
  - .1 Contractor shall use one sensor provided for ambient temperature sensing and second sensor provided for pipe temperature sensing for each 460 controller.
  - .2 Contractor shall be able to program the controller to keep the heating cable powered in case of temperature sensor failure.
- .12 Approval: Complete heat trace system (heating cable, connection kits, and controller) shall be listed by a nationally recognized testing laboratory (NRTL), and marked for intended freeze protection of metallic and non-metallic piping associated with HVAC, Plumbing.

## 2.5 MULTI-CIRCUIT DIGITAL CONTROLLER

- .1 Control and monitor pipe freeze protection using a centralized control system with distributed power and control modules.
  - .1 Basis-of Design Product: RAYCHEM; ACS-30.
- .2 Multi-Application: Distributed digital control system shall be pre-programmed parameters to provide concurrent control for heating cables used for pipe freeze protection, flow maintenance, HVAC piping, hot-water-temperature maintenance, surface snow melting, roof and gutter de-icing, freezer frost heave prevention and floor heating applications.
- .3 Central User Interface Terminal: For all programming.
  - .1 Basis-of Design Product: RAYCHEM; ACS-UIT3.
  - .2 Certification: c-CSA-us Certified.
  - .3 Terminal Display: Color LCD display with password protection to prevent unauthorized system access.
  - .4 Capable of communicating with up to 52 power control panels, where each panel can control up to five circuits and accept up to five temperature inputs.
  - .5 Digital control system shall be capable of assigning up to four temperature inputs per heat-tracing circuit.
  - .6 Capable of communicating with up to 16 remote monitoring modules, where each module can accept up to eight temperature inputs.
  - .7 USB port to allow for quick and easy software update.
  - .8 Programmable Alarm Contacts: Three, including alarm light on enclosure cover.
  - .9 Provide separate offline software tool to allow users to preprogram digital control system and transfer program via USB drive or Ethernet.
  - .10 Enclosure: NEMA 4 for indoor or outdoor locations.
- .4 Power Control Panels:
  - .1 Basis-of-Design Products: RAYCHEM; ACS-PCM2-5.
  - .2 Certification: c-UL-us Listed.
  - .3 Enclosure: NEMA 4/12 enclosure approved for nonhazardous indoor and outdoor locations.
  - .4 Provide ground-fault and line current sensing alarming, switching and temperature inputs for five heat-tracing circuits.
  - .5 Contactors: 3-pole, 30A contactors, EMR type. Quantity: Five.
  - .6 Capable of operating at 120 to 277 V.
  - .7 Alarm contact, including alarm light on panel cover.
- .5 Digital Controller:
  - .1 Integrated adjustable GFPD (10 to 200 mA).
  - .2 Capable of being configured for On/Off, ambient sensing, PASC, and timed duty cycle control modes based on application. PASC control proportionally energizes power to heating cable to minimize energy based on ambient sensed conditions.

- .3 Upon communication loss with user interface terminal, panels shall control with the last downloaded set point.
- .4 Include built-in self-test feature to verify proper functionality of heating cable system.
- .5 BMS Communication Protocol: BACNet integration required.
- .6 Variables monitored by digital controller and reported back to BMS include the following:
  - .1 Temperature.
  - .2 Ground-fault.
  - .3 Current draw.
  - .4 Power consumption.
  - .5 Associated alarms.
- .7 Approval: Complete heat trace system (heating cable, connection kits, and controller) shall be listed by an NRTL, and marked for intended freeze protection of metallic and non-metallic piping associated with HVAC, Plumbing, Domestic Hot-Water-Temperature Maintenance, and Fire Suppression systems.

## **2.6 HEATING CABLE CONNECTION KITS**

- .1 Basis-of-Design Product: RAYCHEM; RayClic.
- .2 Provide power connections, splices/tees, and end seal kits to properly connect and terminate heating cable circuit along specified length of piping.
- .3 Install splices, tees, and crosses underneath pipe insulation with service loops installed to allow for future service of piping.
- .4 Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized and shall not require cutting into heating-cable core to expose bus wires.
- .5 Certification: c-UL-us Listed
- .6 Locate connection kits above grade for buried applications.

## **2.7 ACCESSORIES**

- .1 Cable Installation Accessories: Fiberglass tape, cable ties, connection kits, and end seals all furnished by manufacturer or as recommended in writing by manufacturer.
- .2 Identification: Provide and install "Electric Heat Traced" labels on exterior of pipe insulation every 10 ft. (3m) on opposite sides of pipe, and on all splices, tees, crosses, and power connections for the entire length of heat traced piping.
- .3 Thermal Pipe Insulation:
  - .1 Pipes to be thermally insulated in accordance with manufacturer's written requirements.
  - .2 Insulation shall be closed-cell in areas subject to freezing and have a flame/smoke spread rating of 25/50.

## **2.8 APPROVED MANUFACTURERS**

- .1 Approved manufacturers shall be:
  - .1 Chromalox
  - .2 Raychem
  - .3 3M
  - .4 Serge Baril
  - .5 Heron Cable Ind.
  - .6 Easy Heat (Emerson)

## **Part 3 Execution**

### **3.1 INSTALLED LOCATIONS**

- .1 Install heat trace in all areas indicated on drawings and where subject to freezing. This includes, but is not limited to:
  - .1 Rain water leader discharging to below grade outside the building.

### **3.2 EXAMINATION**

- .1 Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
  - .1 Prior to installation of heating cable system, verify that all piping, to be heat traced has passed all hydrostatic/pressure test and is signed off by plumbing inspector.
  - .2 Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- .2 Preinstallation Testing:
  - .1 Prior to installation of heating cable on piping, an insulation resistance test shall be performed by installing contractor to ensure integrity of heating cable as describe in installation and maintenance manual.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.3 PREPARATION**

- .1 Protect all heating cable ends from moisture ingress until cable is terminated with end seals.
  - .1 Basis-of-Design Product: RAYCHEM; RayClic-E end seals.

### **3.4 INSTALLATION**

- .1 Install electric heating cable where indicated and in accordance with NFPA 70 and NFPA 13.

- .2 All heat-tracing components including power connections, splices, tees, and crosses or end seal, must be installed above grade and protected from abuse or damage. In accordance with NEC and CEC, electrical connections are not permitted to be installed below grade.
- .3 In the field, all heating cables shall be meggered with a minimum of 2,500 V dc for self-regulating cable. The following field megger readings shall be taken on each heating cable:
  - .1 Heating cable shall be meggered when received at Project site before installation.
  - .2 Heating cable shall be meggered after installation, but before insulation is installed.
  - .3 Heating cable shall be meggered after insulation is installed.
  - .4 Heating cable shall be meggered at final commissioning prior to being energized.
  - .5 Insulation resistance must exceed 1.000 megohms at 2,500 V dc.
  - .6 All results must meet manufacturer's specification.
  - .7 Test cables for electrical continuity during installation.
  - .8 Test insulation integrity before energizing.
  - .9 Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- .4 Install electric heating cables after piping has passed all hydrostatic pressure testing and before insulation is installed.
- .5 Install electric heating cables in accordance with IEEE 515.1.
- .6 Install insulation over piping with electric cables.
- .7 Install warning tape on piping insulation where piping is equipped with electric heating cables.
- .8 Set field-adjustable switches and circuit-breaker trip ranges.
- .9 All heat trace cable shall be fastened to the steel pipes with plastic cable ties or fibreglass tape.
- .10 The cable shall run the entire length of each pipe linearly.
- .11 Power connection kits shall be installed in a weatherproof surface mounted junction box (suitable to house the connection kit) in the location shown on the drawings.
- .12 Provide two runs of cable along the length of piping for all piping greater than or equal to 150mm (6" diameter). Run cable along top and bottom of entire pipe length or as per manufacturer's recommendations.
- .13 **Electrical Division shall provide power to junction box adjacent to heat trace circuit power connection. All other wiring shall be by this contractor to the standards of the Electrical Division.**



### **3.5 MONITOR AND CONTROL PANEL**

- .1 Install in accordance with manufacturer's instructions.
- .2 Locate panel as indicated and mount securely. Plumb, true, and square to adjoining surfaces.
- .3 Mount panel at working height. Maintain 1m clearance in front of panel.

### **3.6 CONNECTIONS**

- .1 Ground equipment to the requirements of the Electrical Division.
- .2 Connect wiring in accordance with the requirements of the Electrical Division.
- .3 Connect heat-tracing controls to fire-alarm system in accordance with NFPA 13. Comply with requirements of the Electrical Division.

### **3.7 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Service: Initial start-up and field testing (commissioning) of system shall be performed by factory technician.
  - .1 System shall be commissioned in accordance with manufacturer's installation and operation manual.
  - .2 Field Visits to be scheduled at the following intervals:
    - .1 Preinstallation training.
    - .2 Final electrical insulation resistance (megger) testing of heating cable after insulation has been installed.
    - .3 Final commissioning including controller programming (if applicable).
  - .3 Technician to verify:
    - .1 Controller parameters are set to the application requirements.
    - .2 Controller alarm contacts are properly connected to the BMS, as applicable.
  - .4 Test cables for electrical continuity during installation.
  - .5 Test insulation integrity before energizing.
  - .6 Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- .2 Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- .3 Cables will be considered defective if they do not pass tests and inspections in accordance with manufacturer's testing requirements.
- .4 Prepare test and inspection reports.

**3.8 PROTECTION**

- .1 Protect installed heating cables, including nonheating leads, from damage and moisture ingress during construction.
- .2 Remove and replace damaged heat-tracing cables.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
  - .1 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .2 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .3 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulating Pipes, Vessels and Round Ducts.
- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM)
  - .1 ASTM C547, Type I and IV, Standard Specifications for Mineral Fibre Pipe Insulation.
  - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  - .3 ASTM C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus.
  - .4 ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .5 ASTM C 921, Practice for Determining the Properties Jacketing Materials for Thermal Insulation.
  - .6 ASTM C1695, Standard Specification for Fabrication of Flexible, Removable, and Reusable Blanket Insulation for Hot Service.
  - .7 ASTM C1729 Standard Specification for Aluminium Jacketing for Insulation.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
  - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC), North American Commercial and Industrial Insulation Standards.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves, and jointing recommendations.

- .3 Submit properly completed detail plates from the North American Commercial and Industrial Insulation Standards manual, applicable to installation types required by this specific section.

### **1.3 INSTALLATION INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

### **1.4 QUALIFICATIONS**

- .1 Installer to have successfully completed apprenticeship program.
- .2 Installer to be specialist in performing work of this section and have at least three (3) years successful experience in this size and type of project, qualified to standards of TIAC.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather, construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

### **1.6 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.
  - .3 "ASJ+" – All Service Jacket – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper, with outer poly film leaving no paper exposed.
  - .4 "ASJ" – All Service Jacket (no outer film) – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper outer layer.

## **Part 2 Products**

### **2.1 MATERIAL LIMITATIONS**

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

## **2.2 FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

## **2.3 INSULATION**

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C335, ASTM C177 or ASTM C518.
- .3 Type A-1: Rigid moulded or wound mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to ASTM C547 Type I and IV.
  - .2 Jacket: to ASTM C1136, Type I, II, III, IV, X.
  - .3 Maximum "k" factor: to ASTM C547.
- .4 Type A-5: Fiberglass pipe and tank insulation:
  - .1 Segmented, flexible fiberglass board bonded to laminated vapor retarder, ASJ or FSK.
  - .2 Complying with ASTM C1393, Type II or Type III Category 2.
  - .3 Maximum "k" value:  $0.037W/M$  (or less)  $\times C^{\circ}@100^{\circ}F$  (38°C) is  $0.26BTU \times IN/H$   $FT^2 \times ^{\circ}F$
  - .4 Jacket: specified in 'Factory-Applied Jackets' Article
- .5 Materials:
  - .1 All materials must be supplied by the same manufacturer.
  - .2 Acceptable Materials:
    - .1 Johns Manville
    - .2 Knauf
    - .3 Manson
    - .4 Owens Corning

## **2.4 INSULATION SECUREMENT**

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm (2") wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.

## **2.5 CEMENT**

- .1 Thermal insulating and finishing cement:
  - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449M.

## **2.6 VAPOUR RETARDER LAP ADHESIVE**

- .1 Water based, fire retardant type, compatible with insulation.

## **2.7 INDOOR VAPOUR RETARDER FINISH**

- .1 Compatible with insulation.

## **2.8 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 Minimum thickness: 20 mm (0.020")
  - .2 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .3 Colours: white.
  - .4 Minimum service temperatures: -29°C (-20°F).
  - .5 Maximum service temperature: 65°C (150°F).
  - .6 Moisture vapour transmission: 0.05 perm.
  - .7 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks are not to be used below ambient temperature (cold) operating systems.
    - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Aluminum:
  - .1 To ASTM C 1729
  - .2 Thickness: 0.50 mm (0.020") sheet.
  - .3 Finish: Smooth.
  - .4 Joining: Longitudinal and circumferential slip joints with 50 mm (2") laps.
  - .5 Fittings: 0.50 mm (0.020") thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 20 mm (3/4") wide, 0.50 mm (0.020") thick at 300 mm (12") spacing.

## **2.9 CAULKING FOR JACKETS**

- .1 Caulking: Silicone clear caulking.

## **Part 3 Execution**

### **3.1 PRE-INSTALLATION REQUIREMENT**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed, and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

### **3.2 INSTALLATION**

- .1 Install in accordance with TIAC, North American Commercial and Industrial Insulation Standards.
- .2 Apply materials in accordance with manufacturers' instructions and this specification.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.
- .4 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- .5 Below ambient/chilled water installation:
  - .1 All pipes, valves, strainers, flanges, unions, and other pipe system components and spec must be properly insulated with correctly completed vapor retarder applied.
  - .2 All insulation material must have properly installed and sealed vapor retarding jacket, including circumferential and longitudinal seams.
  - .3 All penetrations, tears, and punctures must be repaired and sealed with a vapor retarding material with a 0.02 or lower perm rating.
  - .4 Vapor stops must be installed at 18' intervals at all pipe insulation termination points including fittings, flanges, and other changes in direction or other types of piping specialties.
  - .5 All fitting insulation must be of the same type, thickness, and density of the pipe insulation, be premoulded insulation covers or fabricate from the same material as the pipe insulation. Full thickness must be maintained over all fitting surfaces. Blanket insulation with a factory applied vapor retarder facing is unacceptable.
  - .6 A complete vapor retarder must be installed on insulation over fittings before applying final finish. Vapor retarder must extend onto and be sealed to the vapor retarder of the pipe insulation.
  - .7 Additional fitting covers, PVC, or metal must have a vapor retarder seal applied to all longitudinal and circumferential seams in addition to the vapor retarder applied to the fitting insulation.
  - .8 Additional field applied to jackets must not use staples, screws, tacks, or rivets for attachment to avoid puncturing vapor retarder underneath.
  - .9 Insulating support inserts are to be high compressive strength insulation with a rigid shield. No calcium silicate is to be used for insulation on below-ambient operation piping.

### **3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: At expansion joints, valves, primary flow measuring elements, flanges, and unions at equipment.

- .2 Flexible removable blanket insulation covers are not acceptable for below-ambient (cold) operation piping systems. Rigid removable insulation jackets that are vapor retarder exterior material, that can be vapor sealed at the seams, are acceptable on below-ambient (cold) operation piping systems.
- .3 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .4 Insulation:
  - .1 Insulation, fastenings and finishes: same as system.
  - .2 Jacket: As per adjacent insulation.

### 3.4 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry at all times. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

### 3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges, and fittings unless otherwise specified.
- .2 Install insulator and jackets to applicable TIAC codes.
- .3 Insulate ends of capped piping with type and thickness indicated for capped service.
- .4 Thickness of insulation to be as listed in following table:
  - .1 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.
  - .2 All storm piping including all vertical and horizontal piping shall be insulated.

Application	Type	Pipe sizes through (NPS) and insulation thickness mm (")				
		to	32 (1¼")	50 (2")	105 (4")	200 (8")
		25 (1")	40 (1½")	80 (3")	150 (6")	& over
Domestic Water Piping	A-1	25 (1")	25 (1")	40 (1½")	40 (1½")	40 (1½")
Storm Piping	A-1/A-5	25 (1")	25 (1")	25 (1")	25 (1")	25 (1")
Cooling Coil cond. Drain	A-1	25 (1")	25(1")	25 (1")	25 (1")	25 (1")
Sanitary Piping						
Trap Primer Piping	A-1	15 (½")	15 (½")	25 (1")		

- .5 Finishes: Conform to the following table:

<u>Application</u>	<u>Piping</u>	<u>Valves &amp; Fittings</u>
Exposed indoors	PVC	PVC
Exposed in mech. rooms	PVC	PVC
Concealed indoors	N/A	PVC
Exposed		
Outdoors	Aluminum	Aluminum



- .6 Connection: To appropriate TIAC code.
- .7 Finish attachments: SS bands, @ 150 mm (6") oc. seals: closed.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
- .3 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .5 ANSI B16.24, Cast Copper Alloy, Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500.
- .6 ASTM B88M, Specification for Seamless Copper Water Tube (Metric).
- .7 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .8 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- .9 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawing data in accordance with general requirements.

**1.3 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

**Part 2 Products**

**2.1 PIPING**

- .1 Domestic hot, cold and recirculation systems, within building.
  - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
  - .2 **Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.**

**2.2 FITTINGS**

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 Tee drill NPS 25 mm (1") and larger.

## **2.3 JOINTS**

- .1 Solder: 95/5.
- .2 Teflon tape: for threaded joints.
- .3 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F1545, complete with thermoplastic liner.
- .4 Tee drill fittings shall be brazed with silver solder, 45% Ag - 15% Cu or copper phosphorous, 95% Cu, 5% P and non-corrosive flux.

## **2.4 VALVES**

- .1 All valves shall be of commercial grade and of same manufacturer, Lead-Free.
- .2 Acceptable materials:
  - .1 Milwaukee
  - .2 Crane
  - .3 Kitz
  - .4 Apollo

## **2.5 BALL VALVES**

- .1 All valves shall be of commercial grade and of same manufacturer.
- .2 NPS 80 mm (3") and under, soldered:
  - .1 To ANSI B16.18, Class 150.
  - .2 Bronze body, full port stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle, with NPT to copper adaptors.

## **2.6 GATE VALVES**

- .1 NPS 50 mm (2") and under, soldered:
  - .1 Rising stem: to MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, screw-in bonnet, solid wedge disc.
- .2 NPS 50 mm (2") and under, screwed:
  - .1 Rising stem: to MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, screw-in bonnet, solid wedge disc.
- .3 NPS 65 mm (2-1/2") and over, in mechanical rooms, flanged:
  - .1 Rising stem: to MSS SP-70, Class 125, 860 kPa (125 psi), flat flange faces, cast-iron body, OS&Y bronze trim.
- .4 NPS 65 mm (2-1/2") and over, other than mechanical rooms, flanged:
  - .1 Non-rising stem: to MSS SP-70, Class 125, 860 kPa (125 psi), flat flange faces, cast-iron body, bronze trim, bolted bonnet.

## **2.7 GLOBE VALVES**

- .1 NPS 50 mm (2") and under, soldered:
  - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, renewable composition disc, screwed over bonnet.
  - .2 Lockshield handles: as indicated.
- .2 NPS 50 mm (2") and under, screwed:
  - .1 To MSS SP-80, Class 150, 1.03 MPa (150 psi), bronze body, screwed over bonnet, renewable composition disc.
  - .2 Lockshield handles: as indicated.

## **2.8 SWING CHECK VALVES**

- .1 NPS 50 mm (2") and under, soldered:
  - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 NPS 50 mm (2") and under, screwed:
  - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.
- .3 NPS 65 mm (2 1/2") and over, flanged:
  - .1 To MSS SP-71, Class 125, 860 kPa (125 psi), cast iron body, flat flange faces, [regrind] [renewable] seat, bronze disc, bolted cap.

## **2.9 BUTTERFLY VALVES**

- .1 Provide copper tubing grooved valves where indicated.
- .2 NPS 100 mm (4") and over:
  - .1 Bronze body per CDA-836.
  - .2 EPDM/Bronze disk and trim.
  - .3 Two position handle.
- .3 Acceptable material:
  - .1 Victaulic Series 608

## **2.10 BALANCING VALVES**

- .1 Provide brass balancing valves suitable for potable water.
- .2 Brass body, EDPM O-Ring, Polytetrafluoroethylene slip washer and stainless steel spring.
- .3 Connect with dielectric connections.

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**Part 3                      Execution**

**3.1                      INSTALLATION**

- .1      Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .2      Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3      Assemble all piping using fittings manufactured to ANSI standards.
- .4      Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .5      Install CWS piping below and away from HWS and HWC and all other hot piping so as to maintain temperature of cold water as low as possible.
- .6      Connect to fixtures and equipment in accordance with manufacturers instructions unless otherwise indicated.
- .7      Bent tubing is not acceptable.
- .8      Buried tubing:
  - .1          Lay in well compacted washed sand in accordance with AWWA Class B bedding.
  - .2          Bend tubing without crimping or constriction. Minimize use of fittings.

**3.2                      VALVES**

- .1      Isolate equipment, fixtures and branches with ball valves.
- .2      Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

**3.3                      PRESSURE TESTS**

- .1      Conform to requirements of general requirements.
- .2      Test pressure: greater of 1½ times maximum system operating pressure or 860 kPa (125 psi).

**3.4                      FLUSHING AND DISINFECTING**

- .1      Maintain testable RP backflow preventor between municipal water and new plumbing system.
- .2      Ensure a minimum of 90% of plumbing fixtures are installed.
- .3      Flush water mains through available outlets with a sufficient flow of potable water to produce a velocity of 1.5 m/s, within pipe for 10 min, or until foreign materials have been removed and flushed water is clear with backflow protection.
- .4      Provide connections and pumps for flushing as required.
- .5      Open and close valves, and operate fixtures to ensure thorough flushing.

- .6 When flushing has been complete to satisfaction of Consultant introduce a strong solution of Chlorine into water system and ensure that it is distributed throughout entire system.
- .7 Rate of chlorine application to be proportional to rate of water entering pipe.
- .8 Chlorine injection to be close to point of filling water main or at building water service and to occur simultaneously.
- .9 Confirm adequate chlorine residual not less than 50 ppm has been obtained, leave system charged with chlorine solution for 24 h. After 24 h, further samples shall be taken to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- .10 Upon 10 ppm confirmation and 24 hr elapsed time flush line to remove chlorine solution.
- .11 Measure chlorine residuals at extreme end of pipe-line being tested.
- .12 Perform bacteriological tests on water main, after chlorine solution has been flushed out. Take samples daily for minimum of two days. Should contamination remain or reoccur during this period, repeat disinfecting procedure. Specialist contractor shall submit certified copy of test results.
- .13 Take water samples at remote fixtures and service connections.

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Indicate:
  - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
  - .2 Wiring and schematic diagrams.
  - .3 Dimensions and recommended installation.
  - .4 Pump performance and efficiency curves.

**1.2 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section general requirements
- .2 Data to include:
  - .1 Manufacturers name, type, model year, capacity and serial number.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list with names and addresses.

**Part 2 Products**

**2.1 DOMESTIC HOT WATER CIRCULATING PUMPS**

- .1 Capacity as indicated.
- .2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 105C continuous service.
- .3 Motor: drip-proof, with thermal overload protection.
- .4 Supports: provide as recommended by manufacturer.
- .5 Acceptable materials:
  - .1 Bell & Gossett Model
  - .2 Armstrong
  - .3 Taco

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.
- .4 Place 150 mm (6") sand under sump pit tank.

### **3.2 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .3 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 PDI-WH201, Water Hammer Arresters.
- .5 CAN/CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
- .6 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

**1.2 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for all items specified herein.

**1.3 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.
- .2 Data to include:
  - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list.

**Part 2 Products**

**2.1 NON FREEZE WALL HYDRANTS (RECESSED, ENCASED)**

- .1 Recessed, encased, all bronze construction, anti-syphon, non freeze wall hydrant with non-turning operating rod, free floating compression valve, integral vacuum breaker, self draining, replaceable seat and seat washer. Nickel bronze box and hinged cover with operating key lock. NPS 20 mm (¾") hose outlet.
- .2 Acceptable materials:
  - .1 Zurn Z-1300
  - .2 Mifab MHY-20
  - .3 Ancon HY-725
  - .4 Contour C7100

## **2.2 INTERIOR HOSE BIBB**

- .1 20 mm (3/4") diameter brass construction, 200 psi, 180°F pressure and temperature limits, complete with hose connection, and wheel handle straight/angle pattern to suit.
- .2 Provide vacuum breaker complete with hose connection.
- .3 Acceptable manufacturers:
  - .1 Exposed on wall; Watts BD series
  - .2 Surface mounted (piping in wall); Watts SC-3 series
  - .3 Delta
  - .4 Waltec
  - .5 Wilkins
  - .6 Emco

## **2.3 WATER HAMMER ARRESTORS**

- .1 Copper construction, bellows type: to PDI-WH 201.
- .2 Acceptable material:
  - .1 Zurn Z-1700
  - .2 Mifab MWH-100
  - .3 Ancon No. 15

## **2.4 BACK FLOW PREVENTORS**

- .1 The backflow preventor shall prevent backflow by either backpressure or backsiphonage from a cross-connection between potable water lines and substances that are objectionable.
- .2 To CAN/CSA-B64.
- .3 Application: as indicated.
- .4 Reduced pressure principle type up to 50 mm (2") (RP):  
Rated to 180°F and supplied with full port ball valves. The main body and access covers shall be bronze (ASTM B584), the seat ring and all internal polymers shall be NSF® Listed Noryl™ and the seat disc elastomers shall be SILICONE. The first and second check shall be orientated at a 45° angle up-wards and accessible for maintenance without removing the relief valve. Supplied with an air gap adapter.
  - .1 Acceptable materials:
    - .1 Watts 009 ½" - 2"
    - .2 Wilkins 975 XL ½" - 2"
    - .3 Conbraco 40-200 Series

- .5 Reduced pressure principle type from 65 mm (2½") to 250 mm (10") (RP):  
The reduced pressure principle backflow preventer shall be ASSE 1013 approved, and supplied with full port gate valves. The main body and access covers shall be epoxy coated cast iron (ASTM A126 Class B), the seat ring and check valve shall be cast bronze (ASTM B584), the stem shall be stainless steel (ASTM A276) and the seat disc elastomers shall be EPDM. The first and second checks shall be accessible for maintenance without removing the relief valve or the entire device from the line.  
If installed indoors, the installation shall be supplied with an air gap adapter, strainer, and integral monitor switch.
- .1 Acceptable materials:
- .1 Watts 909 2½" - 10"
  - .2 Wilkins 975 2½"- 10" or 375 4" - 6"
  - .3 Conbraco 40-200 Series
- .6 Double check valve assembly (DCVA):  
The double check type backflow preventer shall be ASSE 1015 approved, and supplied with full port ball valves. The main body and access covers shall be bronze (ASTM B584), the seat rings and all internal polymers shall be NSF® Listed Noryl™ and the seat disc elastomers shall be silicone. The first and second checks shall be accessible for maintenance without removing the device from the line.
- .1 Acceptable materials:
- .1 Watts 007 ½" - 2"
  - .2 Wilkins 950XL ¾" - 2"
  - .3 Conbraco 40-100 Series
- .7 Double check valve assembly (DCVA)  
The double check backflow preventer shall be ASSE 1015 approved, and supplied with full port gate valves. The main body and access covers shall be epoxy coated cast iron (ASTM A126 Class B), the seat ring and check valve shall be cast bronze (ASTM B584), the stem shall be stainless steel (ASTM A276) and the seat disc elastomers shall be EPDM. The checks shall be accessible for maintenance without removing the device from the line.
- .1 Acceptable materials:
- .1 Watts 709 2½" - 10"
  - .2 Wilkins 950 2" - 10", 350 4" - 6"
  - .3 Conbraco 40-100 Series
- .8 Back flow preventor with intermediate atmospheric vent:
- .1 Acceptable material:
- .1 Watts Series 9D
  - .2 Wilkins 750
  - .3 Conbraco 40-4A Series

## **2.5 VACUUM BREAKERS**

- .1 To CAN/CSA-B64 Series.
- .2 Atmospheric vacuum breaker (A-VB):
  - .1 Acceptable materials:
    - .1 Watts 288A
    - .2 Conbraco 38-103 Series
    - .3 Wilkins 35
  - .3 Hose connection vacuum breaker (HCVB):
    - .1 Acceptable materials:
      - .1 Watts Series 8
      - .2 Conbraco 38-304-AS
      - .3 Wilkins BFP-8
  - .4 Laboratory faucet intermediate vacuum breaker (LFVB):
    - .1 Acceptable materials:
      - .1 Watts N-LF9
      - .2 Conbraco 38-502-01

## **2.6 PRESSURE REGULATORS**

- .1 Capacity: as indicated.
  - .1 Inlet pressure: 1034 kPa (150 psi).
  - .2 Outlet pressure: 41 kPa (5.9 psi).
- .2 Up to NPS 40 mm (1 1/2") bronze bodies, screwed: to ASTM B62.
  - .1 Acceptable material:
    - .1 Watts Series 25AUB (1/2" - 2")
- .3 NPS 50 mm (2") and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class [B].
  - .1 Acceptable materials:
    - .1 Watts PV-10
    - .2 Conbraco 36 Series
- .4 Semi-steel spring chambers with bronze trim.
  - .1 Acceptable materials:
    - .1 Watts PV-10
    - .2 Conbraco 36 Series

## **2.7 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.
  - .1 Acceptable materials:
    - .1 Watts BD series
    - .2 Emco
    - .3 Chicago
    - .4 Zurn

## **2.8 WATER MAKE-UP ASSEMBLY**

- .1 Complete with backflow preventor, pressure gauge on inlet and outlet, pressure reducing valve to CSA B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.
  - .1 Acceptable materials:
    - .1 Watts
    - .2 Conbraco

## **2.9 WATER METERS**

- .1 [Displacement type to ANSI/AWWA C700] [Turbine type to ANSI/AWWA C701] [Compound type to ANSI/AWWA C702].
- .2 Contractor to coordinate meter with municipality.
- .3 Accessories: remote readout device.
- .4 Acceptable material:
  - .1 Neptune

## **2.10 STRAINERS**

- .1 860 kPa (125 psi), Y type with 20 mm (3/4") mesh, bronze or stainless steel removable screen.
- .2 NPS 50 mm (2") and under, bronze body, screwed ends, with brass cap.
  - .1 Acceptable materials:
    - .1 Watts Series 777SI
    - .2 Crane/Powers
    - .3 Colton 125 YTB
    - .4 Wilkins S Series

- .3 NPS 65 mm (2½") and over, cast iron body, flanged ends, with bolted cap.

- .1 Acceptable materials:

- .1 Watts 77F-D (77F-D-FDA for water service)
  - .2 Crane/Powers
  - .3 Colton 125 YTB
  - .4 Wilkins FS Series

## **2.11 SOLENOID VALVES**

- .1 Two (2) way normally closed all bronze construction.
- .2 Voltage shall be suitable for controlling function.
- .3 Acceptable material:

- .1 Asco

## **2.12 OWNER SUPPLIED EQUIPMENT**

- .1 The mechanical contractor shall supply and install all water, gas, condensate and sanitary piping to the owner supplied equipment. Connection to equipment shall be by this contractor.
- .2 Provide flexible riser stops to all sinks and ball valves to all other equipment.
- .3 Provide backflow preventors on equipment required by the local plumbing inspector.
- .4 Provide flexible gas piping to all gas equipment.
- .5 All equipment in store equipment schedule will be supplied and set in place by Mechanical Contractor unless otherwise noted.
- .6 Coordinate all rough-ins and connection with the supplier on site.
- .7 Owner supplied equipment includes existing relocated equipment.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

### **3.2 NON FREEZE WALL HYDRANTS**

- .1 Install 600 mm (24") above finished grade unless otherwise indicated.

### **3.3 WATER HAMMER ARRESTORS**

- .1 Install on branch supplies to each fixture or group of fixtures and where indicated.

### **3.4 BACK FLOW PREVENTORS**

- .1 Install in accordance with CAN/CSA-B64 Series, where indicated and elsewhere as required by code.
- .2 Pipe discharge to terminate over nearest drain and or service sink.
- .3 Provide test results in manual and leave tag with test results on device.

### **3.5 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Install at bottom of all risers, at low points to drain systems, and as indicated.

### **3.6 STRAINERS**

- .1 Install with sufficient room to remove basket.
- .2 Strainer size to match pipe size.

### **3.7 WATER METERS**

- .1 Coordinate with local water authority for make and model of water meter. Provide water meter and install.
- .2 Install water meter as indicated.
- .3 Install remote readout to acceptance of local water authority and as indicated.
- .4 Install check meter(s) as indicated.

### **3.8 WATER MAKE-UP ASSEMBLY**

- .1 Install with valved bypass.
- .2 Pipe discharge from relief valve to nearest floor drain.

### **3.9 QUALITY CONTROL**

- .1 In context of this paragraph, "verify" to include "demonstrate" to Consultant.
- .2 Timing: commission only after start-up deficiencies rectified.
- .3 Access doors: verify size and location relative to items to be services.
- .4 Adjust to suit site conditions, including, but not necessarily limited to, following:
  - .1 Non-freeze wall, ground hydrants:
    - .1 Verify complete drainage.
    - .2 Verify operation of vacuum breaker.
  - .2 Water hammer arrestors:
    - .1 Verify accessibility.
  - .3 Backflow preventors, vacuum breakers:
    - .1 Verify installation of correct type to suit application.
    - .2 Adjust as necessary to ensure proper operation.
    - .3 Verify visibility of discharge.

- .4 Pressure regulators:
  - .1 Adjust settings to suit installed locations, required flow rates.
- .5 Hose bibbs, sediment faucets:
  - .1 Verify operation.
- .6 Water make-up assembly:
  - .1 Verify operation.
- .7 Water meters:
  - .1 Verify operation.
- .8 Pipeline strainers:
  - .1 Verify accessibility of basket.
  - .2 Clean out during commissioning until system clean.
- .5 Verification:
  - .1 Notify Consultant 48 h before commencing tests.
  - .2 All tests and procedures to be witnessed by Consultant at Consultant's discretion.
  - .3 All reported results subject to verification by consultant.
- .6 Training:
  - .1 Train O&M personnel in start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .7 Demonstrations:
  - .1 Demonstrate full compliance with Design Criteria.
  - .2 Demonstrations also to show completeness of O&M personnel training.

### **3.10 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .3 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 CAN/CSA-B79, Commercial and Residential Drains and Cleanouts.

**1.2                SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for all items specified herein.

**1.3                MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.
- .2 Data to include:
  - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year, and capacity.
  - .2 Details of operation, servicing, and maintenance.
  - .3 Recommended spare parts list.

**Part 2            Products**

**2.1                FLOOR DRAINS**

- .1 Floor drains and trench drains: to CAN/CSA-B79.
- .2 Refer to schedule for types and acceptable manufacturer.

**2.2                CLEANOUTS**

- .1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

- .2 Wall access: face or wall type, stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .1 Acceptable material:
    - .1 Zurn ZSS-1469
    - .2 Mifab C1400-RD
    - .3 Watts CO-480-RD-3
    - .4 Jay R. Smith 4710
- .3 Floor access: rectangular, round, as indicated, cast iron body and frame with adjustable secured 15 mm (½") thick flush mounted heavy duty nickel bronze top and: Plugs: bolted bronze with neoprene gasket.
  - .1 Cover for unfinished concrete floors: nickel bronze round, gasket, vandal-proof screws.
    - .1 Acceptable material:
      - .1 Zurn ZN-1400 – HD or Zurn ZZN-1612
      - .2 Mifab C1100-XR-6
      - .3 Watts CO-200-RX-1-6
      - .4 Jay R. Smith SQ-4-1753-XNBCO-SP-U
  - .2 Cover for terrazzo finish: round polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
    - .1 Acceptable materials:
      - .1 Zurn ZN-1400-Z
      - .2 Mifab C1100-UR-6
      - .3 Watts CO-200-U-1-6
      - .4 Jay R. Smith SQ-4-1753-NBRT-SP-U
  - .3 Cover for VCT tile and linoleum floors: square polished nickel bronze with 15 mm (1/2") thick flush mounted heavy duty nickel bronze cover, complete with vandal-proof locking screws.
    - .1 Acceptable materials:
      - .1 Zurn ZN-1400-T – HD
      - .2 Mifab C1100-TS-6
      - .3 Watts CO-200-TS-1-6
      - .4 Jay R. Smith 4200-U
  - .4 Cover for ceramic tile floors: 15 mm (½") thick heavy duty nickel bronze square, cover complete with gasket, vandal-proof screws, for flush finish.
    - .1 Acceptable material:
      - .1 Zurn ZN-1400 – T-HD or Zurn ZZN-1612
      - .2 Mifab C1100-S-6
      - .3 Watts CO-200-S-1-6
      - .4 Jay R. Smith SQ-4-1753-NBCO-SP-U-Y

- .5 Cover for carpeted floors: round polished nickel bronze with flush cover, complete with stainless steel carpet marker, vandal-proof locking screws.

- .1 Acceptable materials:

- .1 Zurn ZN-1400-HD-CM or ZN-1612-CM
  - .2 Mifab C1100C-S-1-6
  - .3 Ancon CO-200-RC-1-6
  - .4 Smith
  - .5 Contour C3000RMNB

## **2.3 TRAP SEAL PRIMER STATIONS**

- .1 Provide trap primer stations where indicated complete with solenoid valve, backflow preventor, vacuum breaker, NPS 15 mm (1/2") solder ends, NPS 15 mm (1/2") drip line connections.
- .2 Solenoid valve electric characteristics shall be suitable for controlling function.
- .3 Coordinate location and number of trap primer stations with Building Automation System (BAS) contractor.

## **2.4 SOLENOID VALVES (HEADER TRAP SEAL PRIMER)**

- .1 Two (2) way normal closed all bronze construction.
- .2 With integral adjustable cycle time clock control. Timer control to have two dial functions, time between cycles and time held in "open position".
- .3 Suitable for 120V.
- .4 Acceptable material:
  - .1 Asco

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

### **3.2 CLEANOUTS**

- .1 In addition to those required by code, and as indicated, install at base of all soil and waste stacks.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 100 mm (4").

### **3.3 TRAP SEAL PRIMERS**

- .1 Install for all floor, hub and trench drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Consultant.
- .3 Install soft copper tubing to floor drains above grade and polyethylene piping to floor drains below grade.

### **3.4 TRAP SEAL PRIMER STATIONS**

- .1 Provide primer stations where indicated.
- .2 Install for all floor drains and elsewhere, as indicated.
- .3 Install copper piping to floor drains above grade. Install polypropylene piping to floor drains on grade.

### **3.5 TRAINING & DEMONSTRATION**

- .1 Training:
  - .1 Train O&M personnel in start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .2 Demonstrations:
  - .1 Demonstrate full compliance with Design Criteria.
  - .2 Demonstrations also to show completeness of O&M personnel training.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM D2235, Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- .3 ASTM D2564, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .4 CAN/CSA-B181.1, ABS Drain, Waste and Vent Pipe and Pipe Fittings.
- .5 CAN/CSA-B181.2, PVC and CPVC Drain, Waste and Vent Pipe and Pipe Fittings.
- .6 CAN/CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

**Part 2 Products**

**2.1 PIPING AND FITTINGS**

- .1 Buried sanitary, and vent piping to:
  - .1 80 mm (3") and smaller: ABS drain waste and vent pipe to CAN/CSA-B181.1.
  - .2 100 mm (4") and larger: SDR-35 PVC drain waste and vent pipe to CAN/CSA-B181.2.
  - .3 Vent piping: any size, PVC-DWV plastic drain and sewer pipe and fittings CAN/CSA-B181.2.
- .2 Above grade sanitary and vent piping:
  - .1 80 mm (3") and smaller: IPEX: PVC-XFR drain waste and vent pipe to CAN/CSA-B181.2.
  - .2 100 mm (4") and larger: IPEX: PVC-XFR drain waste and vent pipe to CAN/CSA-B181.2.
  - .3 Vent piping: any size, IPEX: PVC-XFR plastic drain and sewer pipe and fittings CAN/CSA-B181.2.
- .3 Use plastic XFR – DWV in pipe chase for urinal piping to 1.5 M (5' –0") above finished floor.
- .4 Where piping pierces a fire separation an approved fire stop system to the approval of authority having jurisdiction shall be used.

**2.2 JOINTS**

- .1 Solvent weld for PVC: to ASTM D2564.
- .2 Solvent weld for ABS: to ASTM D2235.

## **2.3 EXPANSION**

- .1 Provide solvent welded expansion joints as required by manufacturer's recommendations.

## **2.4 VENT FLASHINGS**

- .1 Thaler Stack Jack spun aluminum complete with insulation, cap, and rubber gasket.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction. Install in accordance with manufacturer's instructions.
- .2 Installation of underground pipe
  - .1 Provide all excavation, bedding, backfill, and compaction.
  - .2 Install materials in accordance with Manufacturer's instructions.
  - .3 Use jacks to make-up gasketed joints.
  - .4 Stabilize unstable trench bottoms.
  - .5 Bed pipe true to line and grade with continuous support from firm base.
    - .1 Bedding depth - 100 mm to 150 mm (4" to 6").
    - .2 Material and compaction to meet ASTM standard noted above.
  - .6 Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
  - .7 Trench width at top of pipe -
    - .1 Minimum 450 mm (18") or diameter of pipe plus 300 mm (12"), whichever is greater.
    - .2 Maximum - Outside diameter of pipe plus 600 mm (24").
  - .8 Piping and joints shall be clean and installed according to manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
  - .9 Do not use back hoe or power equipment to assemble pipe.
  - .10 Initial backfill shall be 300 mm (12") above top of pipe with material specified in referenced ASTM standard.
- .3 Place Cleanouts
  - .1 Where shown on Drawings and near bottom of each stack and riser.
  - .2 At every 90 degree change of direction for horizontal lines.
  - .3 Every 15 m (50 ft) of horizontal run.
  - .4 Extend clean out to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts

- .4 Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system so gases pass freely to atmosphere with no pressure or syphon condition on water seal.
- .5 Before piping is covered, conduct tests in presence of Consultant and correct leaks or defective work. Conduct test prior to placing floor slab but after backfill is placed.
  - .1 Fill waste and vent system a minimum of 1.8 m (6 ft) above finished floor with water and show no leaks for 2 hours.
  - .2 Conduct ball test in presence of consultant to ensure proper grade and clear of obstructions.
- .6 Install solvent welded expansion joints as per manufacturer's recommendation. Care is to taken to accommodate ambient temperatures at time of install.
- .7 Vent entire waste system to atmosphere.
  - .1 Discharge 350 mm (14") above roof. Join lines together in fewest practicable number before projecting above roof.
  - .2 Set back vent lines so they will not pierce roof near an edge or valley.
  - .3 Venting shall be 3.5 m (11'-6") from any outdoor air intakes.
- .8 Flash pipes passing through roof with Thaler insulated Stack Jack flashing.
  - .1 Flashing base shall be at least 600 mm (24") square.
- .9 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Underwriters' Laboratories of Canada.
  - .1 ULC-S615 reinforced plastic underground tanks for petroleum products.
- .3 Canadian Environmental Protection Act (CEPA).
  - .1 Storage Tank Systems for Petroleum products and Allied Petroleum Products Regulations. Canada Gazette Part II Vol. 142, No. 13.
- .4 Canadian Council of Ministers of the Environment (CCME).
  - .1 CCME PN 1326, Environmental Code of Practice for underground storage tank systems containing petroleum products and allied petroleum products.
- .5 American National Standards Institute (ANSI).
  - .1 ANSI/NFPA-329, Recommended Practice for Handling Releases of Flammables and Combustible Liquids and Gases.

**1.2            SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with the general conditions.
- .2 Indicate details of construction appurtenances and installation of leak detection system.

**1.3            CLOSEOUT SUBMITTALS**

- .1 Submit operation and maintenance data for tank and appurtenances for incorporation into manual specified in general conditions.

**Part 2            Products**

**2.1            OIL INTERCEPTOR**

- .1 One (1) tank of capacity as indicated on drawings.
- .2 Construction: to ULC-S615, manhole sections and revisions complete with cast iron frame and cover.
- .3 Connections: as indicated.
- .4 Manholes: as indicated.



- .5 The separator shall be designed to remove from process wastewater oil and other floatable material(s), and sediment, sand and other settleable material(s). The effluent shall have no degreasers, surfactants, or emulsifiers. The system shall provide adequate treatment time to limit effluent discharge levels of non-emulsified solvent extractable matter of mineral or synthetic origin to a maximum of 10 PPM and total suspended solids (TSS) to a maximum of 350 ppm to avoid penalties and retrofit as enforced by local pretreatment officials.
- .6 The separator shall minimize turbulence, promote centrifugal separation and settling and prevent re-suspension and scouring of collected materials. Temporary backwater conditions shall not cause trapped contaminants to be re-suspended or scoured from the separator. Each separator shall comprise two cells or chambers, providing integral baffling. Wastewater shall enter below the normal liquid level and tangential to the separator wall. The manufacturer shall provide each separator with cleanout, sample, and ventilation ports together with an extension collar and frame and cover to allow access for removal of oil and solids.
- .7 Each separator shall be constructed using a thixotropic polyester resin specifically designed for the manufacture of reinforced fiberglass products. The resulting material shall be inert, non-corrosive and impervious to retained waste. Each separator shall be suitable for underground installation and shall be installed per the manufacturer's recommendations. A reinforced concrete relieving slab, provided and installed at grade by others, shall enable the separator to be installed beneath traffic loading areas.
- .8 Remote panel: Nema 4 complete with disconnect switch audio alarm. Alarm reset pilot light and dry contact for connection to BAS system.
- .9 Wiring: All control wiring between the tank and the control panel shall be by this contractor. Electrical Division to provide 120V power supply to the panel. Run wiring in conduit to standards of Electrical Division.
- .10 Accessories: Inlet and outlets, sampling ports, venting ports, oil level alarm/monitoring package, remote panel and explosion proof level control with pulse card.
- .11 Warranty: Provide 30-year warranty against leakage, corrosion and structural failure.
- .12 Acceptable Material:
  - .1 Proceptor.

## **2.2 ANCHORAGE**

- .1 Concrete bases: In accordance with Cast-In-Place Concrete Section and Structural Engineer's requirements.
- .2 Provide turnbuckles hold down straps and anchor bolts as indicated and as required by the manufacturer.

## **Part 3 Execution**

### **3.1 INSTALLATIONS**

- .1 Install tanks in accordance with CAN/CSA-B139, National Fire Code of Canada and manufacturer's recommendations and CCME- "Code of Practice".

- .2 Position tanks using lifting lugs and hooks, and where necessary use spreader bars. Do not use chains in contact with tank walls.

**3.2 FIELD QUALITY CONTROL**

- .1 Test tanks for leaks in presence of authority having jurisdiction as per manufacturers requirements.

**3.3 REMOTE PANEL**

- .1 Install in accordance with manufacturer's recommendations.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM D2235, Specification for Solvent Cement for Acrylonitrille-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- .3 ASTM D2564, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .4 CAN/CSA-B181.1, ABS Drain, Waste and Vent Pipe and Pipe Fittings.
- .5 CAN/CSA-B181.2, PVC and CPVC Drain, Waste and Vent Pipe and Pipe Fittings.
- .6 CAN/CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

**Part 2 Products**

**2.1 PIPING AND FITTINGS**

- .1 Buried storm piping to:
  - .1 80 mm (3") and smaller: ABS drain pipe to CAN/CSA-B181.1.
  - .2 100 mm (4") and larger: SDR-35 PVC drain pipe to CAN/CSA-B181.2.
- .2 Above grade storm piping:
  - .1 80 mm (3") and smaller: IPEX: PVC-XFR fire rated drain storm pipe to CAN/CSA-B181.1.
  - .2 100 mm (4") and larger: IPEX: PVC-XFR storm pipe to CAN/CSA-B181.2.
- .3 Where piping pierces a fire separation an approved fire stop system to the approval of authority having jurisdiction shall be used.

**2.2 JOINTS**

- .1 Solvent weld for PVC: to ASTM D2564.
- .2 Solvent weld for ABS: to ASTM D2235.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .2 Installation of underground pipe
  - .1 Provide all excavation, bedding, backfill, and compaction.
  - .2 Install materials in accordance with Manufacturer's instructions.

- .3 Use jacks to make-up gasketed joints.
- .4 Stabilize unstable trench bottoms.
- .5 Bed pipe true to line and grade with continuous support from firm base.
  - .1 Bedding depth - 100 mm to 150 mm (4" to 6").
  - .2 Material and compaction to meet ASTM standard noted above.
- .6 Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
- .7 Trench width at top of pipe -
  - .1 Minimum 450 mm (18") or diameter of pipe plus 300 mm (12"), whichever is greater.
  - .2 Maximum - Outside diameter of pipe plus 600 mm (24").
- .8 Piping and joints shall be clean and installed according to manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
- .9 Do not use back hoe or power equipment to assemble pipe.
- .10 Initial backfill shall be 300 mm (12") above top of pipe with material specified in referenced ASTM standard.
- .3 Place Cleanouts
  - .1 Where shown on Drawings and near bottom of each stack and riser.
  - .2 At every 90 degree change of direction for horizontal lines.
  - .3 Every 15 m (50 ft) of horizontal run.
  - .4 Extend clean out to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts
- .4 Before piping is covered, conduct tests in presence of Consultant and correct leaks or defective work. Conduct test prior to placing floor slab but after backfill is placed.
  - .1 Fill waste and vent system a minimum of 1.8 m (6 ft) above finished floor with water and show no leaks for 2 hours.
  - .2 Conduct ball test in presence of consultant to ensure proper grade and clear of obstructions.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
  - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
  - .2 Wiring and schematic diagrams.
  - .3 Dimensions and recommended installation.
  - .4 Pump performance and efficiency curves.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance and engineering data for incorporation into manual specified in general requirements
- .2 Data to include:
  - .1 Manufacturer's name, type, model year, capacity, and serial number.
  - .2 Details of operation, servicing, and maintenance.
  - .3 Recommended spare parts list with names and addresses.

**Part 2 Products**

**2.1 WATER SOFTENER (COMMERCIAL MANIFOLD SYSTEMS)**

- .1 Provide one complete water softener system, including all mineral tanks, brine tanks, control valves, control panels, and flow distributors for a complete and operable system.
- .2 Manifold systems that are pre-piped or field piped are acceptable.
- .3 The system capacity shall be as follows:
  - .1 Total capacity of all tanks: 81,000 grains.
  - .2 Regeneration: 81,000 grains between cycles, based on a regeneration of 10 lbs. of salt per cubic foot of resin.
  - .3 Minimum Number of Mineral Tanks: two.
  - .4 Flow Rate:
    - .1 Minimum flow rate: 30 gpm.
    - .2 Maximum sustained flow rate: 50 gpm.

- .3 Temporary Peak Flow: 50 gpm.
  - .4 Acceptable decrease in flow during regeneration: 50 percent.
- .4 Maximum dimensions shall be as follows:
  - .1 Refer to drawings for space allocation.
- .5 Mineral Tank:
  - .1 Top opening, with premium quality polyethylene liner with FRP filament winding mineral tank.
  - .2 Maximum operating pressure up to 150 psig with a maximum operating temperature of 120° Fahrenheit.
  - .3 Mineral tank must be NSF/ANSI Standard 44.
  - .4 Ion-Exchange resin shall be bead-form with a minimum of 8% cross link gel type sodium form high capacity polystyrene ion-exchange resin with a performance capacity of 30,000 grains per cubic foot when regenerated with 15 lbs of salt per cubic foot. The resin shall be solid, of the proper particle size and contain no plates, shells, agglomerates, or other shapes which might interfere with the function of the water softener. Resin shall be tested and certified WQA according to NSF/ANSI, 61, 372, and WQA Gold Seal.
- .6 Collection and Distribution: High impact, FDA approved ABS hub and lateral high flow distributor at the bottom and an upper basket at the top of the assembly shall be utilized to evenly collect and distribute the flow of water over the entire bed.
- .7 Brine Tank: High density polyethylene combination salt storage/brine tank complete with salt grid platform for dry salt storage. The brine tank shall be of dry salt design.
- .8 Brine Float: Brine float to prevent brine tank from overflowing. The brine float is to be enclosed inside of the brine well with cap and secured.
- .9 Control Valve: Each mineral tank shall be provided with a control valve of epoxy coated lead free brass, with all wet parts being non-corrosive. Control valve shall utilize a remote inline electronic flow meter with Hall Effect sensor, installed on the outlet port of the control valve. Control valve will have a single main piston, patented 1-piece compressible seal/spacer stack assembly, and have an internal brine regenerated piston. Valve must be a top mount design with a 12 volt electronic microprocessor controller. Control valve shall have a fully adjustable regeneration cycle duration times for backwash, downflow brine/slow rinse, 2<sup>nd</sup> flow, fast rinse, soft water brine refill and return to service. The control valve shall also be equipped with a drain port and brine port. The control valve shall be certified to NFS/ANSI 61 and NSF/ANSI 372.
- .10 System Controller:
  - .1 A single, wall mounted system controller enclosed a NEMA rated hinged access panel.
  - .2 The system controller shall be provided with a 120 volt power cord for installation.

- .3 The controller shall be a solid state microprocessor, with a user friendly front panel design for programming and multicoloured LED status indicators for online, standby and regeneration. A multicolor backlit display, indicating current time, day of the week and date, as well as days until next regeneration, current system flow rate and total system volume used shall be provided.
- .4 The controller shall be capable of operating all units in the manifold assembly. All units in the manifold assembly shall be wired to the control panel.
- .5 The controller shall be programmed to provide a Progressive Flow system, utilizing no hard water bypass valves, alternating between units or opening or closing water flow based on flow rate demand. The progressive flow control system shall allow multiple control valves to become a multi-tank, progressive flow system with one unit online at all times and the remaining units in standby or regeneration. Only one unit shall be in regeneration at any given time. The progressive flow system shall use a predetermined flow rate set point to bring additional units online to meet peak flow requirements. Once the flow rate set point is reached for greater than 30 seconds, the units in stand-by will be driven online. The 30 second delay shall be bypassed if the flow exceeds 120% of the set point. Once the peak flow rate demand decreased to 90% of the set point for greater than 1 minute that standby units that were driven on shall return to standby mode. The system shall determine the need for regeneration based on a unit reaching zero capacity or day override, whichever comes sooner.
- .6 The system controller shall have a USB interface for future software updates.
- .7 The system shall have a battery backup.
- .11 No Hard Water Bypass Valve: No hardwater bypass valve shall prevent the raw water bypass during the regeneration cycle at a time while the other units are in service. The No hardwater bypass valve must be certified to NSF/ANSI 61 and NSF/ANSI-372.
- .12 Turbine and Volumetric Meter: Sensor shall be magnetic pulse Hall Effect turbine remote meter. Accuracy must be +/- 5% with a flow rate to suit the selected equipment.
- .13 Acceptable Manufacturers:
  - .1 Canature WaterGroup
  - .2 Excalibur
  - .3 Myers

### **Part 3 Execution**

#### **3.1 WATER SOFTENER**

- .1 Install in accordance with manufacturer's recommendations and as indicated.
- .2 Provide initial charge of salt, minimum of 80 kg (160 lb).

#### **3.2 START-UP AND TRAINING**

- .1 Equipment supplier shall provide raw water testing, programming, and individual start up for each softener column, setting up system operation.

- .2 Equipment supplier shall provide 2 hours of training on equipment to owner's maintenance personnel.

### **3.3 FIELD QUALITY CONTROL**

- .1 Check power supply.
- .2 Check starter protective devices.
- .3 Start up, check for proper and safe operation.
- .4 Demonstrate equipment operation as directed by consultant.
- .5 Demonstrate water softener regeneration controls.

### **3.4 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
  - .2 Manifold System Warranty
    - .1 Fibreglass mineral tanks 10 years
    - .2 Brine Salt Storage tanks 5 years
    - .3 Exchange resin 5 years
    - .4 Control Valves and Electronics 5 years
    - .5 All other Components 5 years
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .3 CAN/CSA C22.2 No. 110, Construction and Test of Electric Storage Tank Water Heaters.
- .4 CAN/CSA-C191, CSA Standards on Performance of Electric Storage Tank Water Heaters for Domestic Hot Water.
- .5 CAN/CSA-C309, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
  - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
  - .2 Wiring and schematic diagrams.
  - .3 Dimensions and recommended installation.
  - .4 Pump performance and efficiency curves.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance and engineering data for incorporation into manual specified in general requirements
- .2 Data to include:
  - .1 Manufacturer's name, type, model year, capacity, and serial number.
  - .2 Details of operation, servicing, and maintenance.
  - .3 Recommended spare parts list with names and addresses.

**Part 2 Products**

**2.1 ELECTRIC WATER HEATER (100 LITRE TANK TYPE)**

- .1 To CAN/CSA C22.2 No. 110, CAN/CSA-C191, with one (1) immersion type element, 18000 W (61.4 MBH), and surface mounted or immersion type adjustable thermostats, power requirements: 575/3/60.
- .2 Tank: 100 l (26 gal), glass lined steel, 700 mm (28") diameter x 1757 mm (70.25") high, 50 mm (2") mineral wool or fibreglass insulation, enameled steel jacket, integral hi-limit safety shut-off switch and side connections.

- .3 Acceptable manufacturers:
  - .1 AO Smith DSE-100A
  - .2 Ruud
  - .3 Bradford White

## **2.2 WATER HEATER TRIM AND INSTRUMENTATION**

- .1 Drain valve: NPS 25 mm (1") with hose end.
- .2 Thermometer: 100 mm (4") dial type with red pointer and thermowell filled with conductive paste.
- .3 Thermowell filled with conductive paste for control valve temperature sensor.
- .4 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
- .5 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

## **Part 3 Execution**

### **3.1 WATER HEATER**

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Provide structural steel for horizontal (vertical) mounted tanks.
- .3 Provide insulation between tank and supports.
- .4 Provide neutralizing cartridge on each vent drain.

### **3.2 FIELD QUALITY CONTROL**

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.
- .2 Check power supply.
- .3 Check starter protective devices.
- .4 Start up, check for proper and safe operation.
- .5 Check settings and operation of all hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .6 Demonstrate equipment operation as directed by consultant.

**3.3            WARRANTY**

- .1      Warranty Start Date:
  - .1      Warranty period starts as of the date of Ready for Takeover.
  - .2      Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2      Warranty Duration:
  - .1      Electric water heaters, three (3) year warranty
- .3      Warranty Coverage:
  - .1      Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
  - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
  - .2 Wiring and schematic diagrams.
  - .3 Dimensions and recommended installation.
  - .4 Pump performance and efficiency curves.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance and engineering data for incorporation into manual specified in general requirements
- .2 Data to include:
  - .1 Manufacturer's name, type, model year, capacity, and serial number.
  - .2 Details of operation, servicing, and maintenance.
- .3 Recommended spare parts list with names and addresses.

**Part 2 Products**

**2.1 DOMESTIC HOT WATER EXPANSION TANK**

- .1 Pre-charged hydropneumatic steel expansion tank complete with internal butyl diaphragm.
- .2 Tank construction shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code, with all welds conforming to ASME Section IX. The tank must be stamped with a maximum working pressure of 150 psi and a maximum working temperature of 250°F.
- .3 Tank volume: as indicated.
- .4 Acceptance factor / volume: as indicated.
- .5 Acceptable material:
  - .1 Amtrol
  - .2 Well-X-Trol

## **2.2 DOMESTIC HOT WATER CIRCULATING PUMPS**

- .1 Capacity: as indicated.
- .2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 105°C (220°F) continuous service.
- .3 Motor: drip-proof, with thermal overload protection.
- .4 Supports: provide as recommended by manufacturer.
- .5 Acceptable materials:
  - .1 Grundfos
  - .2 Bell & Gossett
  - .3 Armstrong
  - .4 Taco

## **2.3 THERMOSTATIC HIGH-LOW MIXING VALVES (4 Port)**

- .1 Thermostatic mixing valve shall consist of a liquid filled thermal motor and piston control mechanism with positive shut-off of hot water when cold water supply is lost. Valve allows a restricted cold water flow in the event of loss or interruption of the hot water supply. All flow is shut off in the event of thermostatic failure.
- .2 Construction: Bronze body and cap with replaceable corrosion resistant components, including stainless steel piston and liner.
- .3 Valve shall come equipped with integral check stops, thermometer, removable strainers, and surface mounted stainless steel cabinet.
- .4 Valve shall control temperature within  $\pm 3^{\circ}\text{F}$ .
- .5 Thermostatic mixing valve shall be ASSE 1017, UPC and CSA certified.
- .6 Cabinet: surface mounted, 18 gauge stainless steel body and door, cylinder lock, and inlet/outlet knockout holes for mounting flexibility.
- .7 Acceptable materials:
  - .1 Bradley HL130
  - .2 Symmons

## **2.4 ANCHOR BOLTS AND TEMPLATES**

- .1 Supply for installation by other Divisions.

## **Part 3 Execution**

### **3.1 RECIRCULATING PUMP**

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.

### **3.2 DOMESTIC HOT WATER EXPANSION TANK**

- .1 Adjust expansion tank pressure to suit system pressure.
- .2 Provide an expansion tank on the cold water feed to each water heater complete with lockshield type shutoff valve at inlet to tank.
- .3 Provide an expansion tank at the water entrance.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.
- .2 Check power supply.
- .3 Check starter protective devices.
- .4 Start up, check for proper and safe operation.
- .5 Check settings and operation of all hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .6 Adjust flow from water-cooled bearings.
- .7 Adjust impeller shaft stuffing boxes, packing glands.
- .8 Demonstrate equipment operation as directed by consultant.
- .9 Demonstrate water softener regeneration controls.

### **3.4 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL REQUIREMENTS**

- .1 Conform to Sections of Division 1 and to General Mechanical Requirements Section.

**1.2 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Perform work in accordance with the recommendations of and the requirements of:
  - .1 Local and district bylaws and regulations.
  - .2 N.F.P.A.14 "Installation of Standpipe and Hose Systems".
  - .3 The Ontario Building Code.
  - .4 U.L.C. or Factory Mutual approval for hose, valve and extinguisher requirements.
  - .5 N.F.P.A.10 "Standard for Portable Fire Extinguishers".
  - .6 The Ontario Fire Code.

**1.3 SUBMITTALS**

- .1 Submit shop drawings and maintenance data in accordance with general requirements.

**1.4 COORDINATION**

- .1 Confirm fire extinguisher cabinet locations and quantities from both architectural and mechanical drawings and report any discrepancies to consultant prior to bid close.
- .2 Coordinate location of cabinet with other trades and provide protection against damage during construction.

**Part 2 Products**

**2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS (CLASS ABC)**

- .1 Stored pressure rechargeable type with hose and shut off nozzle, ULC labelled for A, B and C class protection as indicated. Size of extinguishers shall be as follows:
  - .1 Kitchen Type 'K' 10 lb 20BC rating
  - .2 Mechanical Rooms 10 lb ABC rating
  - .3 Apparatus Rooms 10 lb ABC rating
  - .4 Corridor/Office/Finished Areas 5 lb ABC rating complete with cabinet
  - .5 Acceptable materials:
    - .1 Wilson & Cousins
    - .2 National

## **2.2 CABINETS**

- .1 Recessed mounted type of a size sufficient to contain all necessary components. Tub to be constructed of 1.5 mm (16 gauge) steel and finished with Wilco "Pro-Tech" Premier white painted finish. Adjustable frame comprising of 180° opening door and trim to be separate assembly adaptable to any type of finished wall. Trim to have 6 mm (1/4") return on outer edges with full length semi-concealed piano hinge, and Corbin style latching device.
- .2 Doors and trim to be 1.5 mm (16 gauge) white painted finish. Door glass to be 6 mm (1/4") Duo Lite Safety Glass.
- .3 Cabinet to maintain fire resistive rating of construction in which they occur.
- .4 Do not provide cabinets for mechanical room and service area fire extinguishers unless indicated.
- .5 Acceptable material:
  - .1 Wilson & Cousins Model IE - 105R (5 and 10 lb. Class)
  - .2 National

## **2.3 IDENTIFICATION**

- .1 Identify extinguishers in accordance with recommendations of NFPA 10.
- .2 Attach tag or label to extinguishers indicating month and year of installation and provide space for the addition of recording service dates.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Provide portable fire extinguisher cabinets and mount in wall during construction. Cabinet to be surface or recessed mounted as indicated on the drawings. Install cabinets so that the door will not obstruct normal traffic when open.
- .2 Hang extinguishers in cabinets with wall mounting bracket.
- .3 Prior to installing the extinguisher cabinets, confirm the mounting height and exact location with the Consultant. Mount extinguisher so top of unit is not more than 1.5 m (5').
- .4 Install wall mounted fire extinguishers complete with wall mounting bracket where indicated and/or directed on site by consultant.
- .5 Caulk perimeter of fire extinguisher cabinets after acceptance.

### **3.2 TESTS**

- .1 Fire protection equipment shall be tested to the requirements of NFPA10, NFPA13, NFPA14 and comply with the requirements of the authorities having jurisdiction.



**3.3 RANGE HOOD**

- .1 10 lb type K fire extinguisher next to range hood.

**3.4 FIRE BLANKET**

- .1 Hang blanket on wall in cabinet as indicated, to manufacturers' recommendations.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CAN/CSA B45S1, Supplement #1 to CAN/CSA B-45 Series Plumbing Fixtures.
- .3 CAN/CSA-B45 Series, CSA Standards on Plumbing Fixtures.
- .4 CAN/CSA-B125.3, Plumbing Fittings.
- .5 CAN/CSA-B651, Accessible Design for the Built Environment.

**1.2            SHOP DRAWINGS**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Indicate, for all fixtures and trim:
  - .1 Dimensions, construction details, roughing-in dimensions.
  - .2 Factory-set water consumption per flush at recommended pressure.
  - .3 For water closets, urinals: minimum pressure required for flushing.

**1.3            CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data including monitoring requirements for incorporation into manual specified in general requirements.
- .2 Include:
  - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2 Details of operation, servicing, maintenance.
  - .3 List of recommended spare parts.

**1.4            PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION**

- .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
- .2 Equipment installed by others.
  - .1 Connect with unions.
- .3 Equipment not installed.
  - .1 Capped with valves for future connection by others.

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**Part 2                      Products**

**2.1                      MANUFACTURED UNITS**

- .1        Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2        Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.
- .3        Exposed plumbing brass to be chrome plated.
- .4        Number, locations: Architectural drawings to govern.
- .5        Fixtures in any one location to be product of one manufacturer and of same type.
- .6        Trim in any one location to be product of one manufacturer and of same type.

**2.2                      FIXTURE CARRIERS**

- .1        Provide factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.
- .2        Acceptable materials:
  - .1        Zurn
  - .2        Smith
  - .3        Ancon

**2.3                      PLUMBING FIXTURES**

- .1        Refer to plumbing fixture schedule on the drawings for fixture type, manufacturer, trim, drainage supply, and accessories.

**2.4                      FIXTURE PIPING**

- .1        Hot and cold water supplies to each fixture/faucet:  
Chrome plated flexible supply pipes each with screwdriver stop, reducers, escutcheon and chrome plated nipple.
  - .1        Acceptable materials:
    - .1        Delta 47T900 Series
    - .2        McGuire
- .2        Waste:  
Open grid strainer, or pop up as indicated, offset open grid strainer on Barrier-Free fixtures, cast brass fittings with tubular piping, chrome plated, rubber gasket compression fitting, and overflow flange.
  - .1        Acceptable materials:
    - .1        Delta 33T200 Series
    - .2        McGuire

- .3 'P' Traps:  
Cast brass P trap with cleanout on each fixture not having integral trap.  
Chrome plated in all exposed places.
  - .1 Acceptable materials:
    - .1 Delta 33T300 Series
    - .2 McQuire

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified. Confirm mounting height(s) with consultant prior to rough-in.
  - .2 Wall-hung fixtures: measured from finished floor.
  - .3 Physically Barrier-Free: to comply with most stringent of either NBCC or CAN/CSA B651.
- .2 Drinking fountains:
  - .1 In accordance with CAN/CSA B45S1.

### **3.2 ADJUSTING**

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments.
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
  - .3 Adjust flush valves to suit actual site conditions.
  - .4 Adjust urinal flush timing mechanisms.
  - .5 Adjust water cooler, drinking fountain flow stream to ensure no spillage.
  - .6 Automatic flush valves for water closets and urinals: set controls to prevent unnecessary flush cycles during silent hours.
- .3 Checks.
  - .1 Water closets, urinals: flushing action.
  - .2 Aerators: operation, cleanliness.
  - .3 Vacuum breakers, backflow preventors: operation under all conditions.
  - .4 Wash fountains: operation of flow-actuating devices.
  - .5 Refrigerated water coolers: operation, temperature settings.
- .4 Thermostatic controls.
  - .1 Verify temperature settings, operation of control, limit and safety controls.

- .5 Floor and wall mounted fixtures: caulk to floor or wall using silicone caulking to make water tight, colour to match fixture.
- .6 Counter mounted fixtures: lay fixtures into bead of caulking to ensure excess moisture does not reach the cut edge of the countertop. Clean excess caulking off outside the sink.

### **3.3 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.

**END OF SECTION**

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**Part 1                    General**

**1.1                    REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels – Division 1.
- .3 ASTM B241, Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
- .4 ASTM B221, Extruded Aluminum Alloy Tubes for General Purpose Applications.
- .5 ASTM B85/B85M-18, Standard Specification for Aluminum-Alloy Die Castings.
- .6 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .7 ASTM A181/181M, Specification for Carbon Steel Forgings, for General Purpose Piping.
- .8 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
- .9 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .10 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .11 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500.
- .12 ASTM B88M, Specification for Seamless Copper Water Tube (Metric).
- .13 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch.
- .14 CSA B51, - Boiler, Pressure Vessel, and Pressure Piping Code.
- .15 ASME B31.3, Process Piping.

**1.2                    SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Mechanical General Requirements.

**1.3                    MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in Mechanical General Requirements.

**1.4                    TSSA REGISTRATION AND APPROVAL**

- .1 Provide TSSA application, register, inspect, and final certification of the compressed air systems.
- .2 Obtain and prepare all documents to make the application for registration of the compressed air system, including signature by property owner.
- .3 Complete all necessary registration and coordination with TSSA as required until approved.

- .4 Obtain approval certificates and post at the compressor unit, in the Machine Room and where required by TSSA.
- .5 Provide final approved site inspection on the compressed air system by a TSSA authority.
- .6 Pay all fees to obtain the certificate, post certificate, and TSSA inspections.

**Part 2 Products**

**2.1 AIR COMPRESSOR AND RECIEVER (SCBA)**

- .1 Supplied by Owner, installed by mechanical contractor.

**2.2 REFRIGERATED AIR DRYER (SCBA)**

- .1 Supplied by Owner, installed by mechanical contractor.

**2.3 COMBINATION FILTER-REGULATOR (SCBA)**

- .1 Supplied by Owner, installed by mechanical contractor.

**2.4 AIR COMPRESSOR (APPARATUS BAY)**

- .1 General:
  - .1 Two stage, air-cooled, reciprocating, horizontal, tank-mounted V-belt driven.
- .2 Motor: standard protected, 3.73 Kw (5hp).
- .3 Control:
  - .1 Manual control with H-0-A starter switch.
  - .2 Pressure switch to cut out at 860 kPa (125 psig) and with minimum differential pressure.
- .4 Accessories:
  - .1 Belt guard pressure switch, flexible connection and pressure gauges.
  - .2 Pressure relief valve and automatic drain.
  - .3 Rubber in shear vibration isolators.
- .5 Air intakes:
  - .1 Complete with bird screen, replaceable cartridge type intake filter and silencer.
- .6 Capacity:
  - .1 9.24 l/s (19.8 scfm) of free air. 1034 kPa (150 psig). 635 RPM.
- .7 Vibration isolation:
  - .1 95% minimum efficiency.

- .8 Integral receiver tank.
  - .1 450 mm (18") diameter x 1206 mm (12") long horizontal tank: to CSA B51, ANSI/ASME Section VIII and provincial regulations, for working gauge pressure of 1034 kPa (150 psig). Capacity: 80 US gal.
  - .2 Inlet and outlet connections: NPS 20 mm (3/4") diameter.
  - .3 Accessories: adjustable pressure regulator, safety valve, 125 mm (5") diameter gauge with pressure range of 0 to 1500 kPa (0 to 200 psig), drain cock and automatic condensate trap.
  - .4 Provincial inspector's certificate and label.
  - .5 Finish: shop primed, ready for field painting.
  - .6 Acceptable materials:
    - .1 DeVilbiss
    - .2 Atlas Copco
    - .3 Ingersol Rand
- .9 Acceptable materials:
  - .1 DeVilbiss TAP-5052
  - .2 Atlas Copco
  - .3 Ingersol Rand

## **2.5 REFRIGERATED AIR DRYER (APPARATUS BAY)**

- .1 Self-contained, hermetically sealed, complete with air cooled heat exchanger, compressor, automatic controls, moisture removal trap, wiring, piping and refrigerant charge.
- .2 Inlet and outlet connections to be factory insulated.
- .3 Capacity:
  - .1 16.5 l/s (35 scfm) at an atmospheric dew point of minus 35°C (-30°F), inlet air at evaporator. 20°C (68°F), air to condenser.
- .4 Electrical supply: 120 V, 1 phase, 60 cycle, 0.99 kW.
- .5 Acceptable materials:
  - .1 DeVilbiss DVH25
  - .2 Atlas Copco
  - .3 Ingersoll Rand

## **2.6 COMBINATION FILTER-REGULATOR (APPARATUS BAY)**

- .1 Factory assembled, heavy-duty with mounting bracket and low-pressure side relief valve.
- .2 Maximum inlet pressure: 860 kPa (125 psig).
- .3 Operating temperature: minus 18°C (0°F) to plus 52°C (125°F).
- .4 Filter element: 40 microns. Bowls: polycarbonate.



- .5 Pressure range in regulator: 34 kPa (5 psig) to 860 kPa (125 psig).
- .6 Gauge range: 0 kPa (0 psig) to 1030 kPa (150 psig).
- .7 Acceptable materials:
  - .1 DeVilbiss
  - .2 Aro
  - .3 Fluidair Iwc.

## **2.7 HOSE REELS**

- .1 Ceiling mounted complete with 15M of 15 mm (1/2") 1.5 MPa (220 psi) hose.
- .2 Provide male end quick connect on hose.
- .3 Acceptable material:
  - .1 Nederman Series 883

## **2.8 COPPER PIPE SYSTEM**

- .1 PIPING
  - .1 Compressed air, within building.
    - .1 Above ground; copper tube, hard drawn, type L: to ASTM B88M.
- .2 FITTINGS
  - .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.
  - .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
  - .3 Cast copper, solder type: to ANSI B16.18.
  - .4 Wrought copper and copper alloy, solder type: ANSI/ASME B16.22.
  - .5 Tee drill NPS 25 mm (1") and larger.
- .3 JOINTS
  - .1 Brazed:
    - .1 Fittings: wrought copper to ANSI/ASME B16.22.
    - .2 Joints: silver solder, 45% Ag, 15% Cu or copper phosphorus, 95% Cu 5% P and non-corrosive flux.
  - .2 Teflon tape: for threaded joints.
  - .3 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F1545, complete with thermoplastic liner.
- .4 VALVES
  - .1 All valves shall be of commercial grade and of same manufacturer.
  - .2 NPS 80 mm (3") and under, brazed:
    - .1 To ANSI B16.18, Class 150.
    - .2 Bronze body, full port stainless steel, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle, with NPT to copper adaptors.

.3 Acceptable materials:

- .1 Crane
- .2 Kitz
- .3 Nibco

**2.9 BALL VALVES**

- .1 Three-piece design or top entry for ease of in-line maintenance.
  - .1 To ASTM A181/A181M, Class 70, carbon steel body socket welded or screwed ends, carbon steel ball and associated trim suitable for compressed air application.
  - .2 To withstand 1100 kPa (150 psig) maximum pressure on low pressure systems.
  - .3 To withstand 2060 kPa (300 psig) maximum pressure on high pressure systems.
- .2 Acceptable materials:
  - .1 Worcester
  - .2 Neuman Hattersley
  - .3 Apollo

**2.10 COUPLERS/CONNECTORS (Quick Connectors)**

- .1 Industrial interchange series, full-bore.
- .2 Maximum inlet pressure: 225 psig.
- .3 Valve seat: Buna – N/Nitrile.
- .4 Body: high impact fiberglass composite with nickel plated brass backnut.
- .5 Accepts ¼ industrial type plugs meeting military specification MIL-C-1409.
- .6 Push to connect operation.
- .7 Downstream pressure is vented, and disconnection is performed at zero pressure.
- .8 Acceptable materials:
  - .1 Topring - pneumatic female quick coupler.
  - .2 Aro.
- .9 Confirm quick-connect fitting selection with owner for compatibility with standard air tool fitting & owner's equipment fittings.

**2.11 APPARATUS BAY HOSE REELS**

- .1 Provide hose reels for compressed air services where indicated on drawings.
- .2 Hose reels shall be Samson 505 Series by Ronnoco Sales (or equal).

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**Part 3                      Execution**

**3.1                      COMPRESSOR STATION**

- .1                      Install on vibration isolators on housekeeping pad.
- .2                      Install to manufacturer's recommendations.

**3.2                      REFRIGERATED AIR DRYER**

- .1                      Install to manufacturer's recommendations.
- .2                      Install 3-valve bypass.
- .3                      Install tee connection after dryer for emergency connection to instrument control air system.

**3.3                      COMPRESSED AIR LINE FILTER**

- .1                      Install to manufacturer's recommendations.
- .2                      Install on discharge line from refrigerated air dryer.

**3.4                      MAIN AIR PRESSURE REGULATORS**

- .1                      Install at air compressor station.
- .2                      Install additional regulators on connections to equipment.
- .3                      Install to manufacturer's recommendations.

**3.5                      COMPRESSED AIR PIPING INSTALLATION**

- .1                      Install flexible connection into the following devices:
  - .1                      Compressors
  - .2                      Vibrating equipment
- .2                      Install shut-off valves at outlets, major branch lines and elsewhere as indicated.
- .3                      Install quick-coupler chucks, valves, pressure regulator and pressure gauges on drop pipes.
- .4                      Install unions to permit removal or replacement of equipment.
- .5                      Install tees in lieu of elbows at all changes in direction of piping. Install plug in all open ends of tees.
- .6                      Grade piping at 1% slope minimum.
- .7                      Install compressed air trap and pressure equalizing pipe at each moisture collecting point. Drain pipe to nearest floor drain.
- .8                      Make branch connections from bottom of main.
- .9                      Install compressed air trap at bottom of each riser and at low points in mains, piped to nearest drain (where noted). Distance between drain points to be 30 m (100') maximum.
- .10                      Pipe drain from refrigerated air dryer to nearest drain.

- .11 Screwed piping in accordance with:
  - .1 To ASME code and requirements of authority having jurisdiction.
  - .2 Tapered pipe thread with pulverized lead paste.
- .12 Weld piping in accordance with:
  - .1 To ASME code and requirements of authority having jurisdiction.
  - .2 Weld all concealed and inaccessible piping regardless of size.
  - .3 Weld pipes in accordance with CSA standard and good practices.
- .13 Cleaning:
  - .1 Blow out all piping to clean interior thoroughly of all oil and foreign matter.
- .14 Testing:
  - .1 Pressure test in accordance with requirements of Mechanical General Requirements Section for 4 h minimum, to 1100 kPa (150 psig), with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa (1.5 psig).
- .15 Commissioning:
  - .1 Commission system and demonstrate operation to satisfaction of Consultant.
- .16 Bent tubing is not acceptable.

### **3.6 VALVES**

- .1 Isolate equipment, fixtures, and branches with ball valves.
- .2 Provide isolation valves at piping intersections of piping grid for isolating sections of piping or branches.

### **3.7 PRESSURE TESTS**

- .1 Conform to requirements of general requirements.
- .2 Test pressure: greater of 1½ times maximum system operating pressure or 860 kPa (125 psi).

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL PROVISIONS**

- .1 This section covers items common to all sections of Heating, Ventilation, and Air Conditioning (HVAC) Division.
- .2 Conform to Division 1 General Conditions.
- .3 Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.
- .4 Unless specifically indicated, all materials and equipment provided under this contract shall be new and shall be manufactured in the project year.
- .5 The term “Mechanical Contractor” shall remain active and shall mean a “single contractor” performing plumbing, drainage, heating, cooling, ventilation, and control services.
- .6 When quoting as a subcontractor this building contractor shall explicitly state the services they are providing i.e. Mechanical (all services), Plumbing (water and drainage systems) or HVAC (including hydronic and air systems).
- .7 Contractors shall be explicit to identify whether Fire Protection is included or omitted from the mechanical scope.

**1.2 INTENT**

- .1 Mention herein or indication on Drawings of articles, materials, operations or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for HVAC work.
- .2 Where used, words “Section” and “Division” shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.
- .3 Where used, word “supply” shall mean furnishing to site in location required or directed complete with accessory parts.
- .4 Where used, word “install” shall mean secured in place and connected up for operation as noted or directed.
- .5 Where used, word “provide” shall mean supply and install as each is described above.

**1.3 TENDERS AND BONDING**

- .1 Submit tender based on specified described equipment or Alternates listed.

**1.4 REGULATIONS, PERMITS, AND FEES**

- .1 All materials and quality of work shall meet all current and latest Provincial, Municipal and Fire Marshall requirements, regulations, codes, and by-laws in force in the area of the project.

- .2 Each contractor shall give all necessary notices, obtain all necessary permits, and pay all fees in order that the work shown or specified may be carried out. Each contractor shall furnish any certificates necessary as evidence that the work installed conforms with the laws and regulations of all authorities having jurisdiction.
- .3 In the event that changes, or alterations are required on completed work by authorized inspectors, these changes shall be made at the contractor's expense.
- .4 Special equipment which does not have a standard CSA label shall be inspected by the local electrical authority having jurisdiction and the Approval Certificate shall be submitted to the Consultant as soon as possible. All costs and fees for inspections shall be borne by this contractor.

## **1.5 DRAWINGS**

- .1 The drawings and specifications are not assembled together for responsibility/division between subcontractors. The division of work between subcontractors remains the responsibility of the buildings' contractor (also known as the prime contractor or general contractor).
- .2 All subcontractors are encouraged to perform work amicably utilizing all of the drawings and specifications published by all of the consultants.
- .3 Plumbing and HVAC Drawings do not show structural and architectural and related details. Take information involving accurate measurements of building from building drawings, or at building. Make, without additional charge, any necessary changes, or additions to runs of piping, conduits, and ducts to accommodate structural conditions. Location of pipes, ducts, conduits and other equipment may be altered by Consultant without extra charge provided change is made before installation and does not necessitate major additional material.
- .4 As work progresses and before installing piping, ductwork, heating units, registers, diffusers, fixtures and any other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings, or obtain directions for exact location of such equipment and fitments.
- .5 Plumbing and HVAC drawings indicate general location and route of pipes, ducts and conduits which are to be installed. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Follow building lines, conceal piping, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.
- .6 Install piping and ductwork to clear structural members and any fireproofing. Locate HVAC work to permit installation of specified insulation. Do not remove or damage structural fireproofing. Leave space to permit fireproofing and insulation to be inspected and repaired.
- .7 Before commencing work, check and verify all sizes, locations, grade and invert elevations, levels, and dimensions to ensure proper and correct installation. Verify existing/municipal services.

- .8 Locate all HVAC and electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.
- .9 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install piping and other work so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.
- .10 Relocate equipment and/or material installed but not coordinated with work of other Sections and/or installed incorrectly as directed, without extra charge.
- .11 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

#### **1.6 INTERFERENCE AND COORDINATION DRAWINGS**

- .1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the constructed spaces provided.
- .2 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.
- .3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.
- .4 Upon consultant's request submit copies of interference drawings to consultant.
- .5 Due to the nature of the building and the complexity of the building systems provide the following:
  - .1 Interference drawings, showing coordination of architectural, structural, plumbing, HVAC, and electrical systems for the consultant's review prior to fabrication.
  - .2 Detailed layout drawings, clearly showing fasteners and hangers.
- .6 Provide CAD drawings (minimum file version AutoCAD 2013) in addition to hard copies.

#### **1.7 QUALITY ASSURANCE**

- .1 Perform work in accordance with applicable provisions of local plumbing code, gas ordinances, and adoptions thereof for all HVAC systems. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
- .2 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify Consultant in writing of such differences.

#### **1.8 ALTERNATES AND SUBSTITUTIONS**

- .1 Throughout the HVAC Division and Mechanical Divisions are lists of "Acceptable Alternative" manufacturers acceptable to Consultant if their product meets characteristics of specified described equipment. Submitted Bids shall be based on the supply of named articles and or products as specified in the Bid Documents.

- .2 Each bidder may elect to use “Acceptable Alternative” where listed. Include for any additional costs including all costs for revisions to electrical contract to suit Alternative used.
- .3 When two or more suppliers/manufacturers are named in the Bid Documents, only one supplier/manufacturer of the products named will be acceptable; however, it is the responsibility of this Division to ensure “Alternate Equipment” fits space allocated and gives performance specified. If an “Alternate Equipment” nor “equal” specified product unit is proposed and does not fit space allotted in Consultant’s opinion, supply of specified described equipment will be required without change in Contract amount. Should electrical characteristics for “alternate” or “equal” equipment differ from equipment specified it shall be the responsibility of the equipment manufacturer to pay all costs associated with the revisions to the electrical contract. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.
- .4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.
- .5 If pipe or item, of size or weight indicated, is unobtainable, supply next larger size or heavier weight without additional charge.

## **1.9 EXAMINATION**

- .1 Site Reviews
  - .1 Examine premises to understand conditions which may affect performance of work of this Division before submitting proposals for this work.
  - .2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- .2 Drawings:
  - .1 Plumbing and HVAC Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
  - .2 Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing, HVAC, and Fire Protection Drawings.
  - .3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- .3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.



## **1.10 SEQUENCING SCHEDULING AND COORDINATION**

- .1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Consultant. Should conditions arise where certain changes would be advisable, secure Consultant's approval of these changes before proceeding with work.
- .2 Coordinate work of various trades in installing interrelated work. Before installation of HVAC items, make proper provision to avoid interferences in a manner approved by Consultant. Each Contractor shall refer to all sections of the specification for their responsibilities with other trades. Changes required in work specified in HVAC Division caused by neglect to do so shall be made at no cost to Owner.
- .3 Arrange pipes, ducts, and equipment to permit ready access to valves, unions, traps, starters, motors, control components, and to clear openings of doors and access panels.
- .4 Furnish and install inserts and supports required by HVAC Division unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by HVAC Division.
- .5 Be responsible for required excavation, backfilling, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.
  - .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
  - .2 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
  - .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .6 Adjust locations of pipes, ducts, equipment, fixtures, etc., to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.
  - .1 Make offsets, transitions, and changes in direction of pipes, ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
  - .2 Furnish and install traps, air vents, sanitary vents, pull boxes, etc., as required to effect these offsets, transitions, and changes in direction.

- .7 Slots and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

#### **1.11 REQUEST FOR INFORMATION (RFI) PROCEDURES**

- .1 RFIs shall be submitted to the consultant minimum two (2) weeks prior to answer being required. Failure to submit an RFI in a timely manner will forfeit delay claims and schedule extension requests by the contractor.
- .2 All RFIs will be submitted with the following information:
  - .1 RFI number
  - .2 Name of project
  - .3 Date of initiation
  - .4 Date response required by (minimum two (2) weeks)
  - .5 Subject
  - .6 Submitter's name
  - .7 Drawing/specification reference
  - .8 Photograph of the issue (if applicable)
  - .9 Description of the issue
  - .10 Contractor's proposed resolution

#### **1.12 CONTRACT BREAKDOWN**

- .1 Provide breakdown of contract exclusive of HST to acceptance of consultants prior to first draw submission.
- .2 Provide labour and material cost for each item.
- .3 Breakdown shall indicate total contract amount.
- .4 Contract breakdown shall be as follows as a minimum.

Mobilization and shop drawings (max \$2000.00)

Demolition

Specialty Piping

Boilers

Reheat coils

Circulation pumps

Heating piping

Piping Insulation

Ductwork

Duct Insulation

Grilles & Diffusers

Fire Stopping

Fans & Equipment

HVAC system start up

VRF/Heat Pump Equipment  
Building Automation Systems  
Testing Adjusting and Balancing  
Refrigeration Piping

HVAC contractor closeout requirements (min. of 3% for the first \$500,000.00, 1% from \$500,000.00 to \$5,000,000.00, and 0.5% beyond. Shall not be less than \$5,000.00)

- .5 Progress claims, when submitted are to be itemized against each item of the contract breakdown, this shall be done in table form showing contract amount, work complete to date, previous draw, amount this draw and balance.
- .6 **Mobilization amount may only be drawn when all required shop drawings have been reviewed by the consultant.**

### 1.13 SHOP DRAWINGS AND PRODUCT DATA

- .1 Furnish complete catalog data for manufactured items of equipment to be used in the Work to Consultant for review within 14 days after award of Contract.
- .2 Upon receipt of reviewed shop drawing, product is to be ordered immediately.
- .3 Provide a complete list of shop drawings to be submitted prior to first submission.
- .4 Before submitting to the Consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The Contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.
- .5 If material or equipment is not as specified or submittal is not complete, it will be rejected by Consultant.
- .6 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.
- .7 **Submit all shop drawings for the project as a package. Partial submittals will not be accepted.**
- .8 Catalog data or shop drawings for equipment, which are noted as being reviewed by Consultant or their Engineer shall not supersede Contract Documents.
- .9 Review comments of Consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless Consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- .10 Check work described by catalog data with Contract Documents for deviations and errors.

- .11 Shop drawings and product data shall show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances. e.g., access door swing spaces.
- .12 Shop drawings and product data shall be accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify as to current model production.
  - .5 Certification of compliance to applicable codes.
- .13 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.
- .14 Shop drawings shall be submitted electronically as per the following directions:
  - .1 Electronic Submissions:
    - .1 Electronically submitted shop drawings shall be prepared as follows:
      - .1 Use latest software to generate PDF files of submission sheets.
      - .2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.
      - .3 PDF format shall be of sufficient resolution to clearly show the finest detail.
      - .4 PDF page size shall be standardized for printing to letter size (8.5" x 11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11" x 17".
      - .5 Submissions shall contain multiple files according to section names as they appear in Specification.
      - .6 File names shall include consultant project number and description of shop drawing section submitted.
      - .7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.
      - .8 On the shop drawing use an "electronic mark" to indicate what is being provided.
      - .9 **Each file shall bear an electronic representation of the "company stamp" of the contractor. If not stamped the file submission will not be reviewed.**
    - .2 Email submissions shall include subject line to clearly identify the consultants project number and the description of the shop drawings submitted.

- .3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating “1 of 2” and “2 of 2” in email subject line for the case of two messages.
- .4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.
- .5 On site provide one copy of the “reviewed” shop drawings in a binder as noted above.
- .6 Contractor to print copies of “reviewed” shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

#### **1.14 EQUIPMENT NAMEPLATE DATA**

- .1 Between the manufactures design published literature, the shop drawing submission literature, and the nameplate data on the equipment, they can all read differently.
- .2 Most of the confusion and differences are coming out of the electrical power installation.
- .3 The contractors installing and connecting the equipment are responsible for the coordination of this data through the construction period.
- .4 The contractors shall share and/or request this information through out the project and monitor/make adjustments, provide recommendations accordingly based on any discrepancies.
- .5 The contractors are responsible for any cost associated with the changing data.
- .6 The final installation must meet the “Nameplate Data” on the equipment on site.

#### **1.15 OPERATION AND MAINTENANCE MANUAL**

- .1 Provide operation and maintenance data for incorporation into manual as in submittals’ requirements.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.
- .3 Submit 1 copy of Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless so directed by Consultant. Submission can be done electronically in pdf format or as a hardcopy.
  - .1 Electronic submission/pdf file is required to be bookmarked. Any submission received without bookmarking will be immediately returned as unacceptable.
  - .2 Hardcopy submission shall be in a three-ring binder (minimum 50 mm (2") ring) and labelled as ‘Mechanical Operation and Maintenance Manual’ with project name and location. Dividers are to be used for binder organization.
- .4 Make changes as required and re-submit as directed by Consultant.

- 
- .5 Operation data to include:
    - .1 Control schematics for each system including environmental controls.
    - .2 Description of each system and its controls.
    - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for each system and each component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
    - .8 Spare parts equipment list.
    - .9 Manufacturers standard or extended warranty information.
  - .6 Maintenance data shall include:
    - .1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .7 Performance data to include:
    - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
    - .2 Equipment performance verification test results.
    - .3 Special performance data as specified elsewhere.
    - .4 Testing, adjusting and balancing reports as specified in Testing, Adjusting and Balancing Section.
    - .5 Copy of all substantial performance final certificates.
  - .8 Miscellaneous data to include:
    - .1 Letter of contractor's warranty and guarantee.
    - .2 Index sheet.
    - .3 Tabbed format for each section.
    - .4 Manufacturers approved shop drawings.
    - .5 Spare parts list and source.
    - .6 List of Manufacturers and suppliers address for each piece of equipment.
  - .9 Final Submittals:
    - .1 Upon acceptance of Operation and Maintenance Manual by the Consultant provide the following:
      - .1 Provide two (2) copies of final operation maintenance manuals, as well as a PDF file of the entire approved manual on a USB stick. Only one USB stick is to be provided containing both the approved manual and as-built drawings.

## **1.16 AS-BUILT DRAWINGS**

- .1 Site records:
  - .1 Contractor shall provide 2 sets of reproducible HVAC drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing HVAC systems, control systems and low voltage control wiring.
  - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection at all times.
- .2 As-Built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW HVAC SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
  - .3 TAB to be performed using as-built drawings.
    - .1 Submit hard copy to Consultant for approval. When returned, make corrections as directed.
    - .2 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy on USB stick with Operating and Maintenance Manuals.

## **1.17 WARRANTIES**

- .1 In addition to guarantee specified in General Conditions, guarantee heating, cooling, and plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
- .2 Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record "start-up" date of each piece of equipment on certificate. Include certificates as part of Operation & Maintenance Manual.
- .3 Contractor shall rectify any installation deficiencies in the boiler or pressurized other systems identified by a TSSA Inspector for a period of three (3) years from ready for takeover.
- .4 Warranty period shall start from date of ready for takeover. Warranty period shall start from date of ready for takeover. Warranty start date based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .5 Warranty Duration:
  - .1 Two (2) year warranty period applies unless otherwise noted.
- .6 Warranty Coverage:
  - .1 Applies to parts and labour.

#### **1.18 OCCUPANCY REQUIREMENTS**

- .1 The contractor shall provide the following documentation to the consultant's satisfaction prior to receiving occupancy. Failure to provide the proper documentation will result in the occupancy not being granted. List of required documentation:
  - .1 Final Certificates (required prior to consultant's release of conformance letter).
    - .1 Mandatory TSSA Gas Pressure Test (CSA B149.1)
    - .2 Test Range Hood in accordance with manufacturer's requirements
    - .3 Gas detection system commissioning (Refer to spec section 25 05 21 Part 3)
    - .4 TSSA Test Certificate for Compressed Air System or written confirmation from TSSA that they opted to not inspect the system.
    - .5 TSSA report for new boiler/pressure vessel installation or written confirmation from TSSA that they opted to not inspect the system. (Low pressure systems that have either a wetted heating surface of 30 sq ft (2.89 sq m) or less, or a power rating of 100 MBH (30 kW) or less are exempt.
    - .6 Balancing report for all enclosed apparatus bay ventilation systems.
    - .7 Contractor letter verifying all refrigeration leak detection systems and their interlocks to downstream devices have been installed and tested.

#### **1.19 READY FOR TAKEOVER**

- .1 Complete the following to the satisfaction of the consultant prior to request for ready for takeover.
  - .1 As-Built Drawings.
  - .2 Maintenance Manuals
  - .3 System Start up
  - .4 TAB Reports
  - .5 HVAC System Commissioning
  - .6 Instructions to Owners

#### **1.20 REVISION TO CONTRACT**

- .1 Provide the following:
  - .1 Itemized list of material with associated costs.
  - .2 Labour rate and itemized list of labour for each item.
  - .3 Copy of manufacturers/supplier's invoice if requested.

#### **1.21 DELIVERY, STORAGE, AND HANDLING**

- .1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials. Contractor to include all costs associated with delivery storage and handling in tender price.



- .2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or environmental damaging conditions but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.
- .3 Remove any damaged materials from the site.

**1.22 TSSA INSPECTION**

- .1 Prior to final completion of the project, this contractor shall make application, arrange, and pay for a TSSA inspection of all piping systems and equipment installations, including, but not limited to medical gasses, refrigeration, fuel piping, compressed air, heating plant, cooling plant, and associated equipment installed under the contract.
- .2 Provide a copy of the TSSA report in the maintenance manuals for each system.

**1.23 CONFINED SPACES**

- .1 Certain areas of the building may be defined as a “Confined Space”. Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.
- .2 Refer to building documentation for any spaces deemed “Confined Space”.

**1.24 ENERGY EFFICIENCY**

- .1 All equipment must meet the efficiency of equipment listed in the design and must meet ratings specifically indicated in design documents. This project is energy modeled, and listed equipment energy efficiency must be achieved for funding purposes. Lower efficiency equipment will not be accepted.
- .2 The HVAC systems of this building must achieve the energy efficiency levels by conforming to ANSI/ASHRAE/IESNA 90.1 “Energy Standard for Buildings Except Low-Rise Residential Buildings” and Chapter 2 of Division 3 of SB-10 prescriptive method from the Ontario Building Code.
- .3 All equipment, products, and installations must conform to the Codes and Standards.

**END OF SECTION**

**Part 1            General**

**1.1            TESTS**

- .1 Give 48 hours written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by Consultant.
- .3 Conduct tests in presence of Consultant.
- .4 Bear costs including retesting and making good.
- .5 Piping:
  - .1 General: maintain test pressure without loss for 4 h unless otherwise specified.
  - .2 Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure or minimum 860 kPa, whichever is greater.
  - .3 Test natural gas systems to CSA-B149.1-00, TSSA requirements and requirements of authorities having jurisdiction.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

**1.2            SYSTEM START UP**

- .1 **Provide adjusting testing and start up of all equipment prior to testing and balancing (TAB) specified elsewhere.**
- .2 **Provide consultant with written notice verifying all equipment operation and installation is complete.**
- .3 **Start up shall be in presence of the following: owner or representative, contractor, building automation systems (BAS) contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.**
- .4 Simulate system start up and shut down and verify operation of each piece of equipment.
- .5 Arrange with all parties and provide 72 hours notice for start up procedure.
- .6 Arrange with building automation systems contractor to sequence all components and ensure system operation.

**1.3            DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTION**

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 HVAC contractor to schedule and coordinate the demonstration all on the same day, starting at a pre-approved time and continuing consequently until complete.

- .3 Where specified elsewhere in HVAC Division, qualified manufacturers' representatives who are knowledgeable about the project to provide demonstrations and instructions.
- .4 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Where deemed necessary, Consultants may record these demonstrations on video tape for future reference.

#### **1.4 TRIAL USAGE**

- .1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 HVAC
  - .2 Exhaust air
  - .3 Hydronic water systems
  - .4 Boilers and pumps
  - .5 Control systems

#### **1.5 DEFICIENCIES**

- .1 During the course of construction, the consultants will monitor construction and provide written reports of work progress, discussions, and instruction to correct work.
- .2 Instruction to correct work shall be done within the work period before the next review.
- .3 The contractor shall not conceal any work until inspected.
- .4 The contractor shall expedite 100% complete rough-in work and have inspected prior to concealing services and equipment especially above ceiling.
- .5 Upon completion of the project the consultant will do a final review. Upon receiving the final inspection report, the contractor must correct and sign back the inspection report indicating the deficiencies are completed. A re-inspection will only be done once consultant receives this in writing.

#### **1.6 EQUIPMENT INSTALLATIONS**

- .1 Unions or flanges: provide for ease of maintenance and disassembly.
- .2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.
- .3 Equipment drains: pipe to floor drains.
- .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

#### **1.7 ANCHOR BOLTS AND TEMPLATES**

- .1 Supply anchor bolts and templates for installation by other divisions.

## **1.8 PROTECTION OF OPENINGS**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

## **1.9 ELECTRICAL**

- .1 Electrical work to conform to Electrical Division including the following:
  - .1 Supplier and installer responsibility and related HVAC responsibility is indicated in Equipment Schedule on HVAC and/or electrical drawings
  - .2 Power wiring and conduit is specified in Electrical Division except for conduit, wiring and connections below 50 V which are related to control systems specified in HVAC Division. Follow Electrical Division for quality of materials and workmanship.
  - .3 Electrically operated equipment shall be C.S.A. approved label. Special Inspection Label of Provincial Authority having jurisdiction will be accepted in lieu of C.S.A. approval. Each motor shall have an approved starter. Starter will be supplied and installed by Electrical Division unless otherwise indicated.
  - .4 **All starters for HVAC equipment to be provided by this contractor. Wired by Electrical Division.**

## **1.10 CONTROL WIRING**

- .1 Furnish and install all components, devices, and control wiring for all HVAC equipment, HVAC systems, lighting, and other electrical loads to make all equipment operable to satisfaction of owner and consultant and to manufacturer's requirements and recommendations.
- .2 All electrical wiring, HVAC wiring and installations shall comply with local and national electrical and HVAC codes.
- .3 Supply and install wiring as required for all devices and systems. Install wiring in EMT conduit and otherwise comply with all requirements of the Electrical Division. Approved plenum wire may be used for sensor and network communication wiring where it complies with appropriate building codes and regulatory authorities.
- .4 All wiring concealed in walls and chases, and all exposed wiring shall be run in conduit.
- .5 Provide recessed conduit and backer boxes where controls are wall mounted. Surface mounted boxes and conduit are acceptable in service rooms.
- .6 Free-run plenum rated cable shall be run in cable hangers where provided by electrical division or tied neatly to pipe and duct hangers in the ceiling. Avoid wiring that droops. Follow building lines and do not run wiring "as the crow flies".

## **1.11 MOTORS**

- .1 Provide high efficiency motors for HVAC equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

- .3 Motors under 373 W, (1/2 hp): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.
- .4 Motors 373 W, (1/2 hp) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated.

#### **1.12 BELT DRIVES**

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kW 10 hp: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 10 hp and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .6 Motor slide rail adjustment plates to allow for centre line adjustment.
- .7 Provide sheave changes as required for final air balancing.

#### **1.13 GUARDS**

- .1 Provide guards for unprotected devices.
- .2 Guards for belt drives:
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2 mm (18 gauge) thick sheet metal tops and bottoms.
  - .3 40 mm (1 1/2") diameter holes on both shaft centres for insertion of tachometer.
  - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
  - .1 "U" shaped, minimum 1.6 mm (16 gauge) thick galvanized mild steel.
  - .2 Securely fasten in place.
  - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
  - .1 Wire or expanded metal screen, galvanized, 20 mm (3/4") mesh.
  - .2 Net free area of guard: not less than 80% of fan openings.
  - .3 Securely fasten in place.
  - .4 Removable for servicing.

- .7 Duct Openings
  - .1 Provide reinforced expanded mesh grating, style 3 (3 lbs/sq.ft.) cover on accessible unprotected duct openings over 300 mm (12") wide and as indicated. This includes all ductwork terminating in air handling units and plenums.
  - .2 Securely Fasten in place.
  - .3 Removable for servicing.

#### **1.14 PIPING AND EQUIPMENT SUPPORTS**

- .1 Equipment supports supplied by equipment manufacturer: specified elsewhere in HVAC Division.
- .2 Piping and equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. Concrete specified elsewhere.
- .4 Where housekeeping pads incorporate existing pads provide 10 mm dowels into existing pads. New pad height shall match existing.

#### **1.15 SLEEVES**

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated. Grout sleeves in place.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
  - .1 Through foundation walls.
  - .2 Where sleeve extends above finished floor.
  - .3 Through fire rated walls and floors.
- .4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.
- .6 Fill voids around pipes:
  - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
  - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
  - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
  - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
  - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.

- .7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm clearance all around or to the requirements of the authority having jurisdiction. Seal at wall as indicated.

#### **1.16 FIRE STOPPING**

- .1 This contractor shall work with all other contractors on the project in providing one common method of fire stopping all penetrations made in fire rated assemblies.
- .2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- .3 Do not use cementitious or rigid seals around penetrations for pipe or ductwork where penetrating through walls, floors, ceilings, etc.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barrier at fire separation.
- .5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- .6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- .7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide “fire wrap” blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
- .8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- .9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
- .11 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.
- .12 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.
- .13 Submit product literature and installation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and consultant.
- .14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
- .15 Acceptable Alternate Manufacturers to approval of local authority:
  - .1 Minnesota Mining and Manufacturing
  - .2 Fyresleeve Industries Inc.
  - .3 General Electric Pensil Firestop Systems

- .4 International Protective Coatings Corp.
- .5 Rectorseal Corporation (Metacaulk)
- .6 Proset Systems
- .7 3M
- .8 AD Systems
- .9 Hilti
- .16 Ensure firestop manufacturer representative performs onsite inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

**1.17 ESCUTCHEONS**

- .1 On pipes and ductwork passing through walls, partitions, floors and ceilings in exposed finished areas and on water and drain pipes inside millwork and cabinets.
- .2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
- .3 Outside diameter to cover opening or sleeve.
- .4 Inside diameter to fit around finished pipe.

**1.18 PAINTING**

- .1 Refer to Section Interior Painting and specified elsewhere.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Apply two coats of paint to exposed piping service in service room, base colour as specified in HVAC Identification Section.
- .4 Prime and touch up marred finished paintwork to match original.
- .5 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

**1.19 SPARE PARTS**

- .1 Furnish spare parts in accordance with general requirements and as follows:
  - .1 One set of packing seals for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One head gasket set for each heat exchanger.
  - .4 One set of belts for each type or each size of machinery.
  - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.



**1.20 SPECIAL TOOLS**

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

**1.21 ACCESS DOORS**

- .1 Mud-in type access doors provided by architectural division. Coordinate size and location with Architectural/General division.
- .2 Provide access doors to concealed HVAC equipment for operating, inspecting, adjusting and servicing.
- .3 Flush mounted 600 x 600 mm (24" x 24") for body entry and 300 x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .4 Material:
  - .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.
  - .2 Remaining areas: use prime coated steel.
  - .3 Fire rated areas: provide ULC listed access doors.
  - .4 Washrooms or high moisture area ceilings: Aluminum with mill finish suitable for painting.
- .5 Installation:
  - .1 Locate so that concealed items are accessible.
  - .2 Locate so that hand or body entry (as applicable) is achieved.
- .6 Acceptable materials:
  - .1 Le Hage
  - .2 Zurn
  - .3 Acudor
  - .4 Nailor Industries Inc.

**1.22 DIELECTRIC COUPLINGS**

- .1 General:
  - .1 To be compatible with and to suit pressure rating of piping system.
  - .2 Where pipes of dissimilar metals are joined.
- .2 Pipes NPS 50 mm (2") and under: isolating unions.
- .3 Pipes NPS 65 mm (2 1/2") and over: isolating flanges.

**1.23 DRAIN VALVES**

- .1 Locate at low points and at section isolating valves unless otherwise specified.

- .2 Minimum NPS 20 mm (3/4") unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.
- .3 Drain valves on potable water systems shall be complete with vacuum breaker.

**1.24 REPAIRS, CUTTING, AND RESTORATION**

- .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
- .2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

**1.25 CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units prior to turn over to owner.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

**1.26 DISCONNECTION AND REMOVAL**

- .1 Disconnect and/or remove equipment, piping, ductwork, etc. as indicated.
- .2 Cap and conceal all redundant and obsolete connections.
- .3 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site, which the owner does not retain.
- .4 Store equipment to be retained by owner on site where directed by consultant.

**1.27 OWNER SUPPLIED EQUIPMENT**

- .1 Connect to equipment supplied by the owner and make operable.

**1.28 EXCAVATING AND BACKFILLING**

- .1 Provide all excavating and backfilling inside and outside the building for any buried services. All backfilling shall be new clean granular 'A' fill brought in specifically for the purpose of backfilling to the underside of floor slab. All backfilling shall be compacted at intervals not more than 150 mm (6") layer to the satisfaction of the Consultant.

- .2 Provide excavating and backfilling outside the building with granular A brought in specifically for backfilling to a minimum of 450 mm (18") over the pipe or ductwork. Backfilling outside building over and above the 450 mm (18") backfill as previously specified herein shall be by the HVAC Contractor as specified under Division 2. Where backfilling outside the building is not specified under Division 2 the HVAC contractor shall provide new clean granular 'A' fill to grade level.
- .3 Bottoms of trenches shall be excavated so that the pipe will be supported on a 150 mm (6") compacted bed of clean granular 'A' fill. Provide all necessary pumping to maintain excavation free of water.
- .4 Should water be encountered during excavation, the HVAC contractor shall provide all labour and material, including all equipment required for dewatering the excavation. After the water has been removed, this Contractor shall install a 300 mm (12") base of compacted 50 mm (2") clear stone covered with filter cloth before installing backfill as detailed and/or as specified.
- .5 Be responsible for all weather protection required to install piping and/or equipment to the satisfaction of the Consultant.
- .6 Be responsible for providing all clear stone or granular 'A' material suitable for application to replace existing soil not suitable for backfilling above the 450 mm (18") bedding material.

#### **1.29 CONFINED SPACES**

- .1 Certain areas of the building may be defined as a "Confined Space". Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.
- .2 Refer to building documentation for any spaces deemed "Confined Space".

#### **1.30 TSSA INSPECTION**

- .1 Prior to final completion of the project, this contractor shall make application, arrange, and pay for a TSSA inspection of all piping systems and equipment installations, including, but not limited to medical gasses, refrigeration, fuel piping, compressed air, heating plant, cooling plant, and associated equipment installed under the contract.
- .2 Provide a copy of the TSSA report in the maintenance manuals for each system.

#### **1.31 INTEGRATED LIFE SAFETY SYSTEMS TESTING**

- .1 HVAC systems in this building, including but not limited to smoke control dampers, smoke control fans, high speed low velocity ceiling fans, makeup air units, and heat tracing for fire protection systems may be subject to Integrated Life Safety Systems testing.
- .2 The HVAC Contractor shall coordinate with the Integrated Life Safety Systems Testing Agent as follows:
  - .1 Confirm which HVAC systems are to be included as part of the testing process.

- .2 Verify in writing to the Integrated Life Safety Systems Testing Agent that HVAC commissioning of the affected systems/devices is complete prior to the scheduled testing date(s).
- .3 Participate in the Integrated Life Safety Systems Testing to confirm proper operation of all associated systems.
- .4 This contractor shall work with the Integrated Life Safety Systems Testing Agent to reset all systems back to normal operating mode after the testing is complete.
- .3 Include all costs associated with Integrated Life Safety System Testing in the tender value.
- .4 Refer to Division 1/Division 26 Integrated Life Safety Systems Testing specifications for additional information/requirements.

#### **1.32 REFRIGERANT CONTAINING EQUIPMENT**

- .1 A2L refrigerants are classified as mildly flammable. CSA B52-2023 has specific safety clauses related to the use of refrigerants with this classification within buildings.
- .2 This Contractor shall be responsible to ensure that the installation requirements of CSA B52-2023 are met.
- .3 Throughout this specification various pieces of equipment have been specified with refrigerant leak detection systems. Field wiring of the alarm status of this system to various downstream system components is required under Annex P of the standard and is the responsibility of this Contractor. These devices include the following:
  - .1 Open all zone dampers connected to the affected system.
  - .2 Disable electric reheat coils within the affected system.
  - .3 Activate field installed safety shut off valves on the affected refrigeration systems
  - .4 De energize any potential sources of ignition with the ductwork system of the affected system.
  - .5 Energize fans within the ductwork system.
  - .6 Activate any designated refrigeration leak ventilation systems.

#### **1.33 FREEZE PROTECTION**

- .1 Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection.

#### **1.34 SCAFFOLDING, RIGGING, AND HOISTING**

- .1 Provide all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required. Conform to OSHA requirements and standards.

**1.35 COOPERATION WITH OTHER TRADES**

- .1 Give full cooperation to other trades and furnish in writing to other trades, with copies to the engineer, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- .2 Where plumbing work will be installed in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment. Prepare composite working drawings and sections at a suitable scale, not less than ¼ inches = 1-foot – 0-inches, clearly showing how the HVAC work is to be installed in relation to the work of other trades. If work is installed before coordinating with other trades, or if it causes any interference with work of other trades, make the necessary changes in the work to correct the conditions and bear all costs.
- .3 Furnish to other trades necessary templates, patterns, setting drawings, and shop details for the proper installation of work and for coordinating adjacent work.

**1.36 WATERPROOFING SEAL MATERIALS**

- .1 Modular, compressed seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.
- .2 Standard of quality assurance manufacturers are:
  - .1 Thunderline Corp. (Power Plant Supply Co.) “Link Seal” Model S-316
  - .2 The Metraflex Co. “MetraSeal” type ES
  - .3 Or approved equivalent.

**1.37 SLEEVE, CUT, AND FORMED OPENING LOCATION DRAWINGS**

- .1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses, and formed openings in poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

**1.38 SUSTAINABLE CONSTRUCTION**

- .1 Construction Waste Management:
  - .1 Recycle all waste materials to avoid land fill sites where possible.
  - .2 All metal contents shall be recycled.

- .3 All cardboard and paper shall be recycled.
  - .4 All plastic packaging shall be recycled.
  - .5 All wood shall be directed to the appropriate recycled wood section at the landfill site.
- .2 This contractor is responsible for their own waste management system and cost associated with the disposal. This can be their own on site system, daily removal, back to shop, or a communal system shared with other contractors on site.
  - .3 In all cases the cost to remove materials on site are the cost of this contractor.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B40.100, Pressure Gauges and Gauge Attachments.
- .3 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .4 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Submit manufacturer's product data for following items:
  - .1 Thermometers.
  - .2 Pressure gauges.
  - .3 Stop cocks.
  - .4 Siphons.
  - .5 Wells.

**Part 2 Products**

**2.1 GENERAL**

- .1 Design point to be at mid point of scale or range.
- .2 Ranges: suitable for application.

**2.2 DIRECT READING THERMOMETERS**

- .1 Industrial, variable angle type, liquid filled, 225 mm (9") scale length: to CAN/CGSB 14.4.
  - .1 Acceptable materials:
    - .1 Trerice
    - .2 Winters 91T
    - .3 Wiess

**2.3 REMOTE READING THERMOMETERS**

- .1 100 mm (4") diameter liquid filled activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.
  - .1 Acceptable materials:
    - .1 Trerice
    - .2 Winters Contractor

## **2.4 THERMOMETER WELLS**

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

## **2.5 PRESSURE GAUGES**

- .1 115 mm (4 1/2"), dial type: to ANSI/ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.
  - .1 Acceptable materials:
    - .1 Winters
    - .2 Trerice
    - .3 Wiess
  - .2 Provide:
    - .1 Siphon for steam service.
    - .2 Snubber for pulsating operation.
    - .3 Diaphragm assembly for corrosive service.
    - .4 Gasketed pressure relief back with solid front.
    - .5 Bronze stop cock.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

### **3.2 THERMOMETERS**

- .1 Install in wells on all piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
  - .1 Heat exchangers.
  - .2 Water heating and cooling coils.
  - .3 Water Boilers
  - .4 Boiler Room HWS and HWR.
  - .5 In other locations indicated.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.



### **3.3 PRESSURE GAUGES**

- .1 Install in following locations:
  - .1 Suction and discharge of pumps.
  - .2 Upstream and downstream of PRV's.
  - .3 Upstream and downstream of control valves.
  - .4 Inlet and outlet of coils.
  - .5 Inlet and outlet of liquid side of heat exchangers.
  - .6 Outlet of boilers.
  - .7 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

### **3.4 NAMEPLATES**

- .1 Install engraved lamicoid nameplates as specified elsewhere identifying medium.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American Society for Testing and Materials
  - .1 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A105/A105M, Specification for Carbon Steel Forgings for Piping Applications.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Indicate for each item as applicable:
  - .1 Manufacturer, model number, line contents, pressure and temperature rating.
  - .2 Movement handled; axial, lateral, angular and the amounts of each.
  - .3 Nominal size and dimensions including details of construction and assembly.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit maintenance data in accordance with general requirements.
- .2 Data to include:
  - .1 Servicing requirements, including any special requirements, stuffing box packing, lubrication and recommended procedures.

**Part 2 Products**

**2.1 FLEXIBLE CONNECTION**

- .1 Application: to suit motion.
- .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
- .3 Inner hose: stainless steel corrugated.
- .4 Braided wire mesh stainless steel outer jacket.
- .5 Diameter and type of end connection: as indicated.
- .6 Operating conditions:
  - .1 Working pressure: 1034 kPa (150 psi).
  - .2 Working temperature: 250°C (482°F).
  - .3 To match system requirements.

## **2.2 ANCHORS AND GUIDES**

- .1 Anchors:
  - .1 Provide as indicated.
- .2 Alignment guides:
  - .1 Provide as indicated.
  - .2 To accommodate specified thickness of insulation.
  - .3 Vapour barriers, jackets to remain uninterrupted.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install expansion joints with cold setting, as indicated as instructed by Consultant. Make record of cold settings.
- .2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

### **3.2 APPLICATION**

- .1 Provide on all vibration isolated equipment.
- .2 Provide where requested by equipment manufacturers installation manuals.
- .3 Install in accordance with manufacturer's recommendations.

### **3.3 THERMAL EXPANSION**

- .1 Provide in long runs of heating mains exceeding 100 ft. in length.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .3 American Society for Testing and Materials (ASTM)
  - .1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture Selection, Application, and Installation.

**1.2 DESIGN REQUIREMENTS**

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Submit shop drawings and product data for following items:
  - .1 All bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.

**1.4 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

**Part 2 Products**

**2.1 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

**2.2 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: to ANSI & ULC requirements
  - .2 Ensure steel hangers in contact with copper piping are copper plated.
- .2 Upper attachment structural: Suspension from upper flange of I-Beam or joist.
  - .1 Cold piping NPS 50 mm (2") maximum: Ductile iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
    - .1 Rod: 10 mm (3/8") UL listed
  - .2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed & FM approved.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
  - .1 Cold piping NPS 50 mm (2") maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
  - .2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nuts.
- .4 Shop and field-fabricated assemblies.
  - .1 Trapeze hanger assemblies: ASME B31.1.
  - .2 Steel brackets: ASME B31.1.
- .5 Hanger rods: threaded rod material to MSS SP-58.
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .6 Pipe attachments: material to MSS SP-58.
  - .1 Attachments for steel piping: carbon steel.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for all piping.
  - .4 Oversize pipe hangers and supports to accommodate thermal insulation. Provide 1.5 mm (16 gauge) saddles.

- .7 Adjustable clevis: material to MSS SP-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

- .1 Ensure "U" has hole in bottom for riveting to insulation shields.

## **2.3 RISER CLAMPS**

- .1 Steel or cast iron pipe: black carbon steel to MSS-SP-58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

## **2.4 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>2</sup> (13.12 lbs/ft<sup>2</sup>) density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m (10') span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm (12") long, with edges turned up, welded-in centre plate for pipe sizes NPS 300 mm (12") and over, carbon steel to comply with MSS SP-58.

## **2.5 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of miscellaneous metals, specified herein. Submit calculations with shop drawings.

## **2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **2.7 HOUSE-KEEPING PADS**

- .1 For base-mounted equipment: Reinforced concrete, at least 100 mm (4") high, 150 mm (6") larger all around than equipment, and with chamfered edges as indicated.
- .2 Size of housekeeping pads shall be determined from approved shop drawings.
- .3 Concrete: 30 Mpa concrete with reinforced wire mesh.
- .4 Install all housekeeping pads not indicated on architectural drawings.

## **2.8 OTHER EQUIPMENT SUPPORTS**

- .1 From structural grade steel meeting requirements of structural steel section specified herein.
- .2 Submit structural calculations with shop drawings.

## **2.9 MANUFACTURER**

- .1 Acceptable materials:
  - .1 Grinnell
  - .2 Anvil
  - .3 Myatt
  - .4 Taylor

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to be to industry standards.
  - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: Install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

### **3.2 HANGER SPACING**

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 15 mm (1/2"): every 1.8 m (6').
- .4 Copper piping: up to NPS 15 mm (1/2"): every 1.5 m (5').
- .5 **Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.**

- .6 Within 300 mm (12") of each elbow and:

Maximum Pipe Size: NPS	Spacing Steel	Maximum Spacing Copper
up to 32 mm (1 1/4")	2.1 m (7')	1.8 m (6')
40 mm (1 1/2")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2 1/2")	3.6 m (12')	3.0 m (10')
80 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3 1/2")	3.9 m (13')	3.3 m (11')
100 mm (4")	4.2 m (14')	3.6 m (12')
125 mm (5")	4.8 m (16')	
150 mm (6")	5.1 m (17')	
200 mm (8")	5.7 m (19')	
250 mm (10")	6.6 m (22')	
300 mm (12")	6.9 m (23')	

- .7 Pipework greater than NPS 300 mm (12"): to MSS SP-69.

### 3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Do "NOT" support piping, ductwork and equipment from roof deck, on bottom chord of floor and/or roof joist and/or from OWSJ bridging. Provide structural member between joist.

### 3.4 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4mm (5/32") from vertical.
- .2 Where horizontal pipe movement is less than 15 mm (1/2"), offset pipe hanger and support so that rod hanger is vertical in the hot position.

### 3.5 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.



- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

**END OF SECTION**

**Part 1 General**

**1.1 APPLICATION**

- .1 Seismic restraint is required for all systems and equipment in this building

**1.2 SECTION INCLUDES**

- .1 Seismic Requirements for single rod hanger support for conduit, pipe and other similar systems.
- .2 Seismic Requirements for trapeze type supports for cable tray, conduit, pipe and other similar systems.
- .3 Seismic requirements for all equipment and piping.

**1.3 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Vibration Isolation Measures.

**1.4 REFERENCE STANDARDS**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 National Building Code of Canada (NBC).
- .3 Canadian Standards Association
  - .1 CSA S832, Seismic Risk Reduction of Operation and Functional Components (OFCs) of Buildings.
  - .2 CAN/CSA-S16.1 Limit States Design of Steel Structures
  - .3 CAN3-S136 Design of Cold Steel Structural Members
  - .4 CSA W47.1 Certification of Companies for Fusion Welding of Steel
  - .5 CSA W59 Welded Steel Construction
- .4 SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems
- .5 Canadian Institute of Steel Construction
- .6 Canadian General Standards Board
- .7 Underwriter Laboratories of Canada
- .8 Workers Compensation Board of BC
- .9 American Society of Testing and Materials
  - .1 ASTM A653/S653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (galvannealed) by the Hot Dip Process.
  - .2 ASTM A879M Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.

- .3 ASTM A307 Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .4 ASTM A325M Specification for Structural Bolts, Heat Treated 830MPa Minimum Tensile Strength.
- .10 All local codes.
- .11 FEMA: Federal Emergency Management Activity.
- .12 FEMA: Seismic Restraint Installation Manuals 412. 413 and 414
  - .1 FEMA 412: Installing Seismic Restraints for Mechanical Equipment
  - .2 FEMA 413: Installing Seismic Restraints for Electrical Equipment
  - .3 FEMA 414: Installing Seismic Restraints for Duct and Pipe
- .13 ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.).
- .14 ASHRAE Applications Handbook; Seismic and Wind Restraint Design Chapter.

## 1.5 DEFINITIONS

- .1  $A_v$ : Effective peak velocity related acceleration coefficient BOCA, SBC Code.
- .2  $S_1$ : Mapped Long Period Seismic Acceleration Coefficient IBC, TI-809-04, ASCE7.
- .3  $S_s$ : Mapped Short Period Seismic Acceleration Coefficient IBC, TI-809-04, ASCE7.
- .4  $v$ : Zonal Velocity Coefficient NBC-Canada.
- .5 VISCMA: The Vibration Isolation and Seismic Control Manufacturers Association has developed Testing and Rating Standards for Seismic Restraint Components that comply with Code and ASHRAE based requirements.
- .6 VISCMA 102-2007: Static Qualification Standards for Obtaining a VISCMA Compliant Seismic Component Rating.
- .7  $Z$ : Seismic Zone defines Seismic Coefficient  $C_a$  used by UBC Code.

## 1.6 PERFORMANCE REQUIREMENTS

- .1 Design Ground Acceleration Coefficient ( $A_v$ ,  $S_s$ ,  $v$ , or  $Z$  depending on Code = X.XX).
- .2 (If IBC or TI-809-04) Design Long Period Ground Acceleration Coefficient ( $S_1$  = X.XX).
- .3 Design Soil Type = ( $S_a$ ,  $S_b$ ,  $S_c$ ,  $S_d$ ) as appropriate. (If NBC Canada, the Foundation Factor).
- .4 Importance or Performance Factor appropriate to structure =  $I_p$  = X.XX.
- .5 If UBC Zone 4, Proximity to Fault and, if less than 10km, Fault Type.
- .6 Schedule or drawings indicating critical ( $I_p$  = 1.5) Duct/Piping systems, including systems whose importance factor may be increased by proximity to critical components.

## **1.7 DESCRIPTION OF SYSTEM**

- .1 It shall be understood that the requirements of this seismic restraint section are in addition to other requirements as specified elsewhere for the support and attachment of equipment and HVAC services, and for the vibration isolation of same equipment. Nothing on the project drawings or specifications shall be interpreted as justification to waive the requirements of this seismic restraint section.
- .2 The work under this section shall include furnishing all labour, materials, tools, appliances, and equipment, and performing all operations necessary for the complete execution of the installation of seismic snubber restraint assemblies as shown, detailed, and/or scheduled on the drawing and/or specified in this section of the specifications.
- .3 All seismic snubber restraint assemblies shall meet the following minimum requirements:
  - .1 The snubber/restrained isolator for isolated equipment shall include a resilient element that will ensure that no un-cushioned shock can occur (this does not include cable restraints).
  - .2 It shall be possible to visually inspect the resilient material for damage and allow for replacement, if necessary.
  - .3 All snubbers are to include a maximum air gap of 0.25 in (6 mm).
  - .4 Seismic restraint systems shall be designed to offer seismic restraint in all directions, unless otherwise noted.
  - .5 Seismic restraint capacities to be verified by an independent test laboratory or certified by a registered Professional Engineer to ensure that the design intent of this specification is realized. Verification shall be by one of the following methods:
    - .1 An NRTL (National Recognized Testing Laboratory), or laboratory recommended by VISCMA.
    - .2 Certified by a Professional Engineer with at least 5 years of experience, using industry standard methods of analysis, which employ common engineering practices. Adherence to the ratings standard within ASHRAE SPC171 and VISCMA 102-2007 is required.
    - .3 By a nationally recognized agency, such as VISCMA, that has reviewed and approved the restraint.

## **1.8 SYSTEM DESIGN**

- .1 Seismic restraint manufacturer shall be responsible for the structural design of attachment hardware as required to attach snubbers/restraints to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.
- .2 The contractor shall furnish, to the seismic restraint manufacturer, a complete set of approved shop drawings of all equipment that is to be restrained, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings furnished shall include, at a minimum, basic equipment layout, length, and width dimensions, and installed operating weights of the equipment to be restrained.

- .3 All piping, ductwork and equipment is to be restrained to meet code requirements. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various restraint sizes and anchors, as well as “worst case” reaction loads for each restraint and/or anchor size.
- .4 The contractor shall ensure that all housekeeping pads used are adequately reinforced and are properly dowelled to the building structure, so as to withstand calculated seismic forces. In addition, the size of the housekeeping pad is to be coordinated with the seismic restraint manufacturer to ensure that adequate edge distances exist in order to obtain the desired equipment anchor capacities.

#### **1.9 SEISMIC BRACING AND SUPPORT DESIGN REQUIREMENTS**

- .1 Seismic restraint designer shall coordinate all attachments with the structural engineer of record.
- .2 Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
- .3 Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
- .4 All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in Section 3.01.
- .5 Friction from gravity loads shall not be considered resistance to seismic forces.
- .6 Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14. Sway bracing used for seismic restraint purposes must be fitted with provisions to resist the vertical force component of the diagonal brace. Single diagonal brace for seismic restraint will not be approved.

#### **1.10 ALTERNATE SYSTEMS**

- .1 Provisions of the General Conditions and Supplemental Conditions of the specifications shall govern the use of alternate systems to those specified.
- .2 Manufacturers not listed as approved in “Part 2 Materials” of this section must secure approval to bid a minimum of ten (10) days prior to the project bid date.
- .3 Uncertified internal equipment seismic restraint systems are disallowed for use on this project.

#### **1.11 QUALITY ASSURANCE**

- .1 The contractor shall provide pre-engineered seismic restraint systems to meet total design lateral force requirements for support and restraint of piping, conduit, cable trays and other similar systems and equipment where required by the applicable building code.
- .2 System Supports/Restraints: Firms regularly engaged in the manufacture of products of the types specified in this section, whose products have been in satisfactory use in similar service for not less than 5 years.

- .3 Bolted framing channels and fittings shall have the manufacturers name, part number, and material heat code identification number stamped in the part itself for identification. Material certification sheets and test reports must be made available by the manufacturer upon request.
- .4 Only companies experienced in performing the work of this section shall do the installation.
- .5 All seismic restraint installations shall be independently reviewed by the Owners Representative for compliance with project specifications.

#### **1.12 SUBMITTALS**

- .1 Product Data: Include Seismic Rating Curve for each seismically rated isolator or restraint component.
- .2 Samples: The contractor shall submit samples of specified seismic snubber devices for approval.
- .3 Shop Drawings shall include the following:
  - .1 Design Calculations: Calculate requirements for selecting seismically rated vibration isolators and seismic restraints. Certification documents to be signed and sealed by a qualified Professional Engineer with at least 5 years of experience in the design of seismic restraints. Professional engineer shall have local jurisdiction and provide periodic field review and final certification upon completion of the project. All costs and fees associated with the engineering shall be the responsibility of this contractor.
  - .2 Vibration Isolation Bases: Dimensional drawings including anchorage and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads.
  - .3 Seismic-Restraint Details: Detailed submittal drawings of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors. Include ratings for loads.
  - .4 Equipment Manufacturer Seismic Qualification Certification: The Equipment Manufacturer must submit certification that each piece of provided equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
    - .1 Basis for Certification: Indicate whether the "withstand" certification is based on actual test assembled components or on calculations.
    - .2 Indicate the equipment is certified to be durable enough to:
      - .1 structurally resist the design forces and/or
      - .2 will remain functional after the seismic event.
  - .5 Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - .6 Detailed description of the assumed equipment anchorage devices on which the certification is based.

**1.13 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver strut systems, pipe hangers and components carefully to avoid breakage, denting, and scoring finishes. Do not install damaged equipment.
- .2 Store strut systems, pipe hangers and components in original cartons and in clean dry space; protect from weather and construction traffic.

**1.14 WORK FURNISHED BUT NOT INSTALLED**

- .1 The materials and systems specified in this section shall be purchased by the HVAC contractor from a single seismic snubber restraint materials manufacturer to assure sole source responsibility for the performance of the seismic restraints used.
- .2 The materials and systems specified in this section can, at the contractor's option, be installed by the subcontractor who installs the seismic services.

**1.15 COORDINATION**

- .1 Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting seismically rated equipment. Concrete shall have a minimum compressive strength of 3,000 psi or as specified by the consultant.
- .2 Coordinate with seismic restraint manufacturer to locate and size structural supports underneath seismically restrained equipment (e.g. roof curbs, cooling towers, and other similar equipment).

**1.16 INSTALLATION**

- .1 Installation of all seismic restraint materials specified herein shall be accomplished following the manufacturer's written instructions. Installation instructions shall be submitted to the engineer for approval prior to the beginning of the work.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Unless otherwise specified materials used in the Work shall conform to the following:
  - .1 All steel rolled sections and steel plates shall conform to CAN/CSA G40.21M-300W
  - .2 All steel hollow structural steel sections shall conform to CAN/CSA G40.21-350W Class C
  - .3 Structural steel bolts, nuts and washers shall conform to ASTM A325M
  - .4 Weld electrodes shall be SMAW-E-E480XX and SAW-F480-EXXX.

**2.2 ACCEPTABLE MANUFACTURERS**

- .1 All seismic snubbers and combination restraint/vibration isolation materials specified herein shall be provided by a single manufacturer to assure sole source responsibility for the proper performance of the materials used. Manufacturer is to be a member of VISCMA.

- .2 Anchor types and sizes are to be per the design data as provided by the seismic restraint manufacturer.
- .3 Materials and systems specified herein and detailed or scheduled on the drawings are based upon materials manufactured by Kinetics Noise Control Inc. Materials and systems provided by other manufacturers are acceptable, provided that they meet all requirements as listed in this specification.
- .4 Kinetics Noise Control Inc.
- .5 Cooper 'B' Line.
- .6 Unistrut Building Systems.
- .7 Mason Industries.

## 2.3 SEISMIC SNUBBER TYPES

### GENERAL

(Isolator/Snubber Types contained herein are per ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) Handbook, HVAC Applications, Seismic and Wind Restraint Design)

- .1 Type A, Coil Spring Isolator Incorporated Within a Ductile Iron or Cast Aluminum Housing.
  - .1 Cast iron or aluminum housings are brittle when subjected to shock loading and are therefore not approved for seismic restraint applications.
- .2 Type B, Coil Spring Isolator Incorporated Within A Steel Housing
  - .1 Spring isolators shall be seismic control restrained spring isolators, incorporating a single or multiple coil spring element, having all of the characteristics of free standing coil spring isolators as specified in the vibration isolation portion of this specification. Springs shall be restrained using a housing engineered to limit both lateral and vertical movement of the supported equipment during an earthquake without degrading the vibration isolation capabilities of the spring during normal equipment operating conditions.
  - .2 Vibration isolators shall incorporate a steel housing and neoprene snubbing grommet system designed to limit motion to no more than ¼" (6 mm) in any direction and to prevent any direct metal-to-metal contact between the supported member and the fixed restraint housing. The restraining system shall be designed to withstand the seismic design forces in any lateral or vertical direction without yield or failure. Where the capacity of the anchorage hardware in concrete is inadequate for the required seismic loadings, a steel adapter base plate to allow the addition of more or larger anchors will be fitted to fulfill these requirements. In addition to the primary isolation coil spring, the load path will include a minimum ¼" (6 mm) thick neoprene pad.
  - .3 Spring elements shall be colour coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000-hour rating when tested in accordance with ASTM B-117.



- .4 . To facilitate servicing, the isolator will be designed in such a way that the coil spring element can be removed without the requirements to lift or otherwise disturb the supported equipment.
- .5 Spring isolators shall be Model FHS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (2).
- .3 Type C, Coil Spring Isolator Incorporated Within a Steel Housing
  - .1 Spring isolators shall be seismic control restrained spring isolators, incorporating one or more coil spring elements, having all the characteristics of free standing coil spring isolators per the vibration isolation section of this specification, for equipment which is subject to load variations and/or large external forces. Isolators shall consist of one or more laterally stable steel coil springs assembled into fabricated welded steel housings designed to limit movement of the supported equipment in all directions.
  - .2 Housing assembly shall be made of fabricated steel members and shall consist of a top load plate complete with adjusting and leveling bolts, adjustable vertical restraints, isolation washers, and a bottom load plate with internal non-skid isolation pads and holes for anchoring the housing to the supporting structure. Housing shall be hot dipped galvanized for outdoor corrosion resistance. Housing shall be designed to provide a constant free and operating height within  $\frac{1}{8}$ " (3 mm).
  - .3 The isolator housing shall be designed to withstand the project design seismic forces in all directions.
  - .4 Coil spring elements shall be selected to provide static deflections as shown on the vibration isolation schedule or as indicated or required in the project documents. Spring elements shall be colour coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000-hour rating when tested in accordance with ASTM B-117.
  - .5 Spring isolators shall be Model FLS and FLSS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (3).
- .4 Type D, Coil Spring Isolator Incorporated with Integral Seismic Restraint
  - .1 Spring isolators shall be single or multiple coil spring elements which have all of the characteristics of freestanding coil spring isolators as specified in the vibration isolation portion of this specification, incorporating lateral and vertically restrained seismic housing assemblies. Spring elements shall be readily replaceable without the need to list or remove the supported equipment.

- .2 Restraint housing shall be sized to meet or exceed the force requirements of the application and shall have the capability of accepting coil springs of various sizes, capabilities, and deflections as required to meet the required isolation criteria. All spring forces shall be contained within the coil/housing assembly, and the restraint anchoring hardware shall not be exposed to spring generated forces under conditions of no seismic force. Spring element leveling adjustment shall be accessible from above and suitable for use with a conventional pneumatic or electric impact wrench.
- .3 Restraint element shall incorporate a steel housing with elastomeric elements at all dynamic contact points. Elastomeric elements shall be replaceable. Restraint shall allow  $\frac{1}{4}$ " (6 mm) free motion in any direction from the neutral position. Restraint shall have an overturning factor (ratio of effective lateral snubber height to short axis anchor spacing) of 0.33 or less to ensure optimum anchorage capacity.
- .4 Spring isolators shall be Model FMS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (4).
- .5 Type E, All Direction Neoprene Isolator
  - .1 Vibration Isolators shall be neoprene, molded from oil resistant compounds, designed to operate within the strain limits of the isolator so to provide the maximum isolation and longest life expectancy possible using neoprene compounds. Isolators shall include encapsulated cast-in-place top steel load transfer plate for bolting to equipment and a steel base plate with anchor holes for bolting to the supporting structure. Ductile iron or cast aluminum components are not acceptable alternatives and shall not be used due to brittleness when subjected to shock loading.
  - .2 Isolator shall be capable of withstanding the design seismic loads in all directions with no metal-to-metal contact.
  - .3 Isolator shall have minimum operating static deflections as shown on the project Vibration Isolation Schedule or as otherwise indicated in the project documents and shall not exceed published load capacities.
  - .4 Neoprene isolators shall be Model RQ as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections .2.01, 2.02 and 2.03 (5).
- .6 Type F, Light Capacity All Direction 3-Axis External Seismic Snubber Assembly
  - .1 Equipment shall be restrained against excessive movement during a seismic event by the use of 3-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all three directions, and additional snubbers shall be used as required by seismic design conditions.
  - .2 Snubbers shall be of interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of  $\frac{1}{4}$ " (6 mm) in any direction.

- .3 Snubbers shall include a minimum ¼" (6 mm) thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Maximum neoprene bearing pressure shall not exceed 1500 pounds / sq. inch (10.4 N / sq. mm). Snubber shall be capable of withstanding an externally applied seismic force of up to 3,000 pounds (1360 kg) in any direction. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.
- .4 Three-axis seismic snubbers shall be Model HS-5 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and 2.01, 2.02, and 2.03 (6).
- .7 Type G, Lateral 2-Axis External Seismic Snubber Assembly
  - .1 Equipment shall be restrained against excessive lateral movement during a seismic event by the use of 2-axis horizontal resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all horizontal directions, and additional snubbers shall be used as required by seismic design conditions.
  - .2 Snubbers shall be interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location to a maximum of ¼" (6 mm).
  - .3 Snubbers shall include a minimum of ¼" (6 mm) thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.
  - .4 Two-axis lateral seismic snubbers shall be Model HS-2 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (7).
- .8 Type H, Heavy Capacity All Direction 3-Axis External Seismic Snubber Assembly
  - .1 Equipment shall be restrained against excessive vertical and horizontal movement during a seismic event by the use of 3-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all three directions, and additional snubbers shall be used as required by seismic design conditions.
  - .2 Snubbers shall be of welded interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of ¼" (6 mm) in any direction.

- .3 Snubbers shall include resilient neoprene pads with a minimum thickness of ¼" (6 mm) to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be capable of withstanding an externally applied seismic force up to 10,000 pounds (4,540 kg) in any direction. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.
  - .4 Three-axis seismic snubbers shall be Model HS-7 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (8).
- .9 Type I, Horizontal 1-Axis External Seismic Snubber Assembly
- .1 Equipment shall be restrained against excessive horizontal one-axis movement during a seismic event by the use of single-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of four (4) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all lateral directions.
  - .2 Snubbers shall be of steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location in the direction of impact to a maximum of ¼" (6 mm).
  - .3 Snubbers shall include resilient neoprene pads with a minimum thickness of ¼" (6 mm) to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to eliminate any contact during normal equipment operation.
  - .4 Single-axis seismic snubbers shall be Model HS-1 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (9).
- .10 Type J, Cable Restraints for Suspended Piping and Ductwork
- .1 Seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist project seismic loads, arranged to offer seismic restraint capabilities for piping, ductwork, and suspended equipment in all lateral directions.
  - .2 Building and equipment attachment brackets at each end of the cable shall be designed to permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points as required to eliminate potential for dynamic cable wear and strand breakage.
  - .3 Restraints shall be sized to the capacity of the cable or to the capacity of the anchorage, whichever is lesser.
  - .4 Seismic wire rope connections shall be made using overlap wire rope "U" clips or seismically rated tool-less wedge insert lock connectors.

- .5 Vertical suspension rods shall be braced as required to avoid potential for buckling due to vertical “up” forces. Braces shall be structural steel angle uniquely selected to be of sufficient strength to prevent support rod bending. Brace shall be attached to the vertical suspension rod by a series of adjustable straps. Clips shall be capable of securely locking brace to suspension rod without the need for hand tools.
- .6 Where clevis hanger brackets are used for seismic restraint attachment, they will be fitted with clevis internal braces to prevent buckling of the hanger brackets.
- .7 Seismic cable shall be as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.03 through 1.07 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .8 Seismic cable building and equipment attachment brackets shall be Model KSCA, KSCU, or KSCC as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .9 Seismic cable concrete anchor bolts shall be Model KCAB Wedge, Model KCCAB Cracked Concrete, or Model KUAB Undercut, as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .10 Seismic wire rope connectors shall be (Model KWRC - 'U' clamp) / (Model KWGC - Tool-less wedge lock) as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .11 Seismic vertical suspension stiffener rod clips shall be Model KHRC as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).
- .12 Clevis Internal Braces shall be Model KCHB as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02, and 2.03 (10).

## **2.4 SEISMIC BRACING COMPONENTS**

- .1 Steel strut shall be 1-5/8 wide in varying heights and mig-welded combinations as required to meet load capacities and designs. A material heat code, part number, and manufacturer’s name shall be stamped on all strut and fittings to maintain traceability to material test reports.
- .2 Material for epoxy painted strut: ASTM A1011, SS, Grade 33.
- .3 Material for pre-galvanized strut: ASTM A653, SS, Grade 33.
- .4 Material for hot-dip galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.

- .5 Material for fittings and accessories: ASTM A907, Grade 33, Structural Quality or ASTM A1011, SS, Grade 33.
- .6 Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

## **2.5 UNIFORM BUILDING CODE REQUIREMENTS**

- .1 Seismic Zone Factor to Table 16-I for area of jurisdiction.
- .2 Soil Profile Type to Table 16-J for area of jurisdiction.
- .3 Seismic Importance Factor to Table 16-K for area of jurisdiction.
- .4 Component Amplification Factor to Table 16-O for area of jurisdiction.
- .5 Component Response Mod. Factor to Table 16-O for area of jurisdiction.
- .6 Seismic Coefficient to Table 16-Q for area of jurisdiction.
- .7 The total height of the structure ( $h_t$ ) and the height of the system to be restrained within the structure ( $h_x$ ) shall be determined in coordination with architectural plans and the General Contractor.
- .8 Forces shall be calculated for individual supports using the above information. Exceptions to Table 16-O may be utilized. However, all use of exceptions shall be noted on submitted seismic bracing plan documents.

## **Part 3 Execution**

### **3.1 GENERAL INSTALLATION**

- .1 Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions.
- .2 Refer to FEMA Manuals 412, 413, and 414 for typical industry standard installation guidelines.
- .3 Upon completion of installation of all seismic restraint materials and before start-up of restrained equipment, all debris shall be cleaned from beneath all protected equipment, leaving equipment free to contact snubbers/restraints.
- .4 Torque anchor bolts according to anchor manufacturer's written instructions to resist seismic forces.
- .5 All seismic restraint systems shall be installed in strict accordance with the manufacturer's seismic restraint guidelines manual and all certified submittal data.
- .6 Prior to installation, bring to the architect's/engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- .7 Brace support rods when necessary to accept compressive loads. Welding of compressive braces to the vertical support rods is not acceptable.
- .8 Seismic restraints shall be attached to the structural system. Looping restraints around the system is not acceptable.

- .9 Do not brace a system to two independent structures such as ceiling and wall.
- .10 Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- .11 Seismic restraint cables shall be adjusted such that they are not visibly slack, or the flexibility is approximately 25mm under thumb pressure for a 1500mm cable length (equivalent ratio for other cable lengths).
- .12 All seismic restraint cables shall be at least 25mm clear of all other equipment and services.

### **3.2 EQUIPMENT INSTALLATION**

- .1 All external utility connections to restrained equipment shall be designed to allow differential seismic motion without damage to the equipment or utility connections.
- .2 Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following the manufacturer's written instructions.
- .3 After equipment installation is completed, adjust limit stops following manufacturer's written instructions so that they are out of contact during normal operation.
- .4 Adjust snubbers according to manufacturer's written instructions.
- .5 Installation of seismic restraints shall not cause any change in position of equipment, resulting in stresses or misalignment.
- .6 No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration isolation system specified.
- .7 Do not install any seismic restraint for equipment, cable trays or conduit that compromises isolation specified.

### **3.3 PIPING INSTALLATION**

- .1 Hold down clamps must be used to attach pipe to all trapeze members before applying restraints.
- .2 Branch lines may not be used to restrain main lines.
- .3 Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent piping.
- .4 Attach piping to the trapeze per seismic restraint manufacturer's design. Install cables so they do not bend across sharp edges of adjacent equipment or building structures.

### **3.4 FASTENING TO STRUCTURE**

- .1 Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or wedge-type concrete anchors. Consult structural engineer of record.

- .2 Overstressing of the building structure shall not occur from overhead support of equipment. Bracing attached to structural members may present additional stresses. The contractor shall submit loads to the structural engineer of record for approval in this event.
- .3 Coring is not permitted for the installation of concrete anchors. Use ground penetrating radar or equivalent method of embedment item detection to locate all embed items including reinforcing steel and electrical conduits. Concrete reinforcing steel and electrical conduits shall not be cut or damaged under any circumstances.
- .4 Install vertical braces to stiffen hanger rods and prevent buckling per seismic restraint manufacturer's design. Clamp vertical brace to hanger rods. Requirements apply equally to hanging equipment. Do not weld vertical braces to hanger rods.
- .5 If mounting hole diameter exceeds bolt diameter by more than 0.125" (3 mm), reduce clearance in hole with epoxy grout, flanged elastomeric bushings or welded washer.
- .6 Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors. Refer to seismic restraint manufacturer's written instructions.

### **3.5 INSPECTION**

- .1 The contractor shall notify the local representative of the seismic restraint materials manufacturer prior to installing any seismic restraint devices. The contractor shall seek the representative's guidance in any installation procedures with which he/she is unfamiliar.
- .2 Upon completion of the installation of all seismic restraint devices herein specified, the local representative of the seismic restraint manufacturer shall, at the contractor's request, inspect the completed system and report in writing any installation errors, improperly selected snubber devices, or other fault in the system which could affect the performance of the system.
- .3 The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

### **3.6 PIPING**

- .1 Seismically restrain all piping listed below. Use Type J Cable Restraints for all piping supported by vibration isolation hanger assemblies, including:
  - .1 Natural gas piping, medical gas piping, vacuum piping, petroleum based liquid piping, and compressed air piping equal to or greater than 1" (25 mm) in inside diameter.
  - .2 Brace remainder of piping to code requirements (IBC or TI-809-04) on in conformance with SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition (Remaining Codes).



### **3.7 DUCTWORK**

- .1 Seismically restrain all ductwork listed below. Use Type J Cable Restraints for all ductwork supported by vibration isolation hanger assemblies, including:
  - .1 All rectangular and oval ducts with cross sectional area equal to or greater than 6 sq. ft. (0.55 sq. meters).
  - .2 All round ducts with diameters equal to or greater than 32" (812 mm).
  - .3 Brace remaining ductwork to code requirements (IBC or TI-809-04) or in conformance with SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition (Remaining Codes).

### **3.8 CONDUIT**

- .1 Seismically restrain all electrical conduit listed below. Use Type J Cable Restraints for all conduit supported by vibration isolation hanger assemblies, including:
  - .1 All round ducts with diameters equal to or greater than 32" (812 mm).
  - .2 Brace all conduit to code requirements (IBC or TI-809-04) or in conformance with SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition (Remaining Codes).

### **3.9 ROOF MOUNTED EQUIPMENT**

- .1 Provide seismic restraint for all isolated and non-isolated roof curbs and associated equipment.
- .2 Provide seismically restrained steel coil spring isolation systems where isolation curbs are indicated and non-isolated seismic restraints for all other roof curb systems."

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Provide separate shop drawings for each isolated system complete with performance and product data.

**Part 2 Products**

**2.1 GENERAL**

- .1 Size and shape of bases type and performance of vibration isolation to be as indicated.
- .2 To be of the same manufacturer for all isolation.
- .3 Acceptable materials:
  - .1 Korfund
  - .2 Vibro-Acoustics
  - .3 Vibron

**2.2 ELASTOMERIC PADS**

- .1 Type EP1 - neoprene waffle or ribbed; 10 mm (3/8") minimum thick; 50 durometer; maximum loading 350 kPa (50.8 psi).
- .2 Type EP2 - rubber waffle or ribbed; 10 mm (3/8") minimum thick; 30 durometer natural rubber; maximum loading 415 kPa (60.2 psi).
- .3 Type EP3 - neoprene-steel-neoprene; 10 mm (3/8") minimum thick neoprene bonded to 1.5 mm (16 gauge) steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa (50.8 psi).
- .4 Type EP4 - rubber-steel-rubber; 10 mm (3/8") minimum thick rubber bonded to 1.5 mm (16 gauge) steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa (60.2 psi).
- .5 Acceptable materials:
  - .1 Korfund
  - .2 IAC Acoustics
  - .3 Vibro-Acoustics
  - .4 Vibron

**2.3 ELASTOMERIC MOUNTS**

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of [60]; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

- .2 Acceptable materials:
  - .1 Vibro-Acoustics
  - .2 Korfund
  - .3 IAC Acoustics
  - .4 Vibron

## **2.4 SPRINGS**

- .1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.
- .3 Cadmium plate for all installations.
- .4 Colour code springs.

## **2.5 SPRING MOUNT**

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; leveling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg (2100 lbs) maximum.
- .6 Performance: as indicated.
- .7 Acceptable materials:
  - .1 Korfund
  - .2 IAC Acoustics
  - .3 Vibron
  - .4 Vibro-Acoustics

## **2.6 HANGERS**

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, molded with rod isolation bushing, which passes through hanger box.
- .3 Performance as indicated.

- .4 Acceptable materials:
  - .1 Vibron
  - .2 IAC Acoustics
  - .3 Korfund
  - .4 Vibro-Acoustics

## **2.7 HORIZONTAL THRUST RESTRAINT**

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 10 mm (3/8").
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.
- .3 Acceptable materials:
  - .1 Korfund
  - .2 IAC Acoustics
  - .3 Vibron
  - .4 Vibro-Acoustics

## **2.8 STRUCTURAL BASES**

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm (96") on smallest dimension, split for field welding on sizes over 2400 mm (96") on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm (1") minimum.
- .4 Acceptable materials:
  - .1 Korfund
  - .2 IAC Acoustics
  - .3 Vibron
  - .4 Vibro-Acoustics

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm (1") minimum static deflection as follows:
  - .1 Up to NPS 100 mm (4"): first 3 points of support. NPS 125 mm (5") to NPS 200 mm (8"): first 4 points of support. NPS 250 mm (10") and Over: first 6 points of support.
  - .2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm (2").
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

### **3.2 SITE VISIT**

- .1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Consultant.
- .2 Provide Consultant with notice 24 h in advance of visit.
- .3 Make adjustments and corrections in accordance with written report.

### **3.3 TESTING**

- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Testing Adjusting and Balancing Section.
- .2 Vibration measurements shall be taken for equipment-listed below:
- .3 Provide Consultant with notice 48 h in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations including sound curves.
- .5 Submit complete report of test results including sound curves.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 Canadian Standards Association (CSA).
  - .1 Natural Gas and Propane Installation Code CSA B149.1.
- .4 National Fire Protection Association
  - .1 NFPA 13, Installation of Sprinkler Systems.
  - .2 NFPA 14, Standpipe and Systems.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with General Requirements.
- .2 Product data to include paint colour chips, all other products specified in this section.

**1.3 PRODUCT LITERATURE**

- .1 Submit product literature in accordance with General Requirements.
- .2 Product literature to include nameplates, labels, tags, lists of proposed legends.

**Part 2 Products**

**2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Metal or plastic lamicoid nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

**2.2 SYSTEM NAMEPLATES**

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

- .2 Construction:
  - .1 3 mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned, and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

Size	No. of Sizes mm (")	Height of Line mm (")	Letters mm (")
1	10 x 50 (3/8" x 2")	1 (3/64")	3 (1/8")
2	15 x 75 (1/2" x 3")	1 (3/64")	6 (1/4")
3	15 x 75 (1/2" x 3")	2 (5/64")	3 (1/8")
4	20 x 100 (3/4" x 4")	1 (3/64")	10 (3/8")
5	20 x 100 (3/4" x 4")	2 (6/64")	6 (1/4")
6	20 x 200 (3/4" x 8")	1 (3/64")	10 (3/8")
7	25 x 125 (1" x 5")	1 (3/64")	15 (1/2")
8	25 x 125 (1" x 5")	2 (5/64")	10 (3/8")
9	32 x 200 (1 1/4" x 8")	1 (3/64")	20 (3/4")
  - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
  - .1 Terminal cabinets, control panels: Use size #5.
  - .2 Equipment in Mechanical Rooms: Use size #9.
  - .3 Roof top equipment: use size #9.
  - .4 Equipment above ceiling: use size #1 riveted to ceiling suspension system.

## 2.3 FIRE DAMPER/FIRE STOP FLAP NAMEPLATES/FIRE SMOKE DAMPER

- .1 Colours:
  - .1 Black letters, yellow background.
- .2 Construction:
  - .1 Self adhesive 50 mm x 25 mm, matte finish, with round corners.
- .3 Locations:
  - .1 Install on adjacent ceiling grid. Where fire stop flap is installed in gypsum ceiling install on diffuser/grille frame. Where fire damper is installed above gypsum ceiling install on adjacent wall.

## 2.4 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Consultant.

- .4 Upon completion of this project all references to room names and numbering shall be to the Owner's requirements which may or may 'NOT' be the numbering system used on the drawings. Each contractor shall verify the proper numbering scheme to be used prior to project completion.
- .5 All equipment shall be identified in sequence from the existing equipment and "NOT" duplicate numbering of equipment.

## **2.5 PIPING SYSTEMS GOVERNED BY CODE**

- .1 Identification:
  - .1 Natural and propane gas: To CSA B149.1-00 and authority having jurisdiction and as indicated elsewhere.
  - .2 Sprinklers: To NFPA 13.
  - .3 Standpipe and hose systems: To NFPA 14.

## **2.6 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .3 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75 mm (3"): 100 mm (4") long x 50 mm (2") high.
  - .2 Outside diameter of pipe or insulation 75 mm (3") and greater: 150 mm (6") long x 50 mm (2") high.
  - .3 Use double-headed arrows where flow is reversible.
- .4 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .5 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm (3/4") and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (395°F).



**.6 Colours and Legends:**

- .1 Where not listed, obtain direction from Consultant.
- .2 Colours for legends, arrows: To following table:  

Background colour:	Legend:	Arrows:
Yellow	White	Black
Green	White	Black
Red	White	Black

**.7 Pictograms:**

- .1 **Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.**

**.8 Background colour marking and legends for piping systems:**

<b>CONTENTS</b>	<b>BACKGROUND COLOUR</b>	
	<b>MARKING</b>	<b>LEGEND</b>
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Condensate	Green	CONDENSATE
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Natural gas	Yellow	NATURAL GAS
Gas regulator vents		to Codes

**2.7 IDENTIFICATION DUCTWORK SYSTEMS**

- .1 50 mm (2") high stencilled letters and directional arrows 150 mm (6") long x 50 mm (2") high.
- .2 Colours: Black, or coordinated with base colour to ensure strong contrast.

**2.8 VALVES, CONTROLLERS**

- .1 Brass tags with 15 mm (1/2") stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
- .3 Provide adhesive coloured tab (max. size 15 mm) indication on ceiling to locate valves/equipment above. Same applies to grid. Colour to be approved by consultant.

**2.9 CONTROLS COMPONENTS IDENTIFICATION**

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

- .2 Inscriptions to include function and (where appropriate) fail-safe position.
- .3 Provide equipment identification and/or indication on ceiling to locate devices/equipment above ceiling. Install identification on grid. Colours to be approved by consultant.

## **2.10 LANGUAGE**

- .1 Identification to be in English.

## **Part 3 Execution**

### **3.1 TIMING**

- .1 Provide identification only after all painting specified has been completed.

### **3.2 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.

### **3.3 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection
  - .1 Do not paint, insulate or cover in any way.

### **3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 m (5'-8") intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- .7 At beginning and end points of each run and at each piece of equipment in run.

- .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.5 VALVES, CONTROLLERS**

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively. Where existing numbering system is installed start new numbering system at 100.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma-[89], Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM).
  - .1 ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Mean of the Guarded Hot-Plate Apparatus.
  - .2 ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .3 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .4 ASTM C1729 Standard Specification for Aluminum Jacketing for Insulation.
  - .5 ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
  - .6 ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes And Tanks.
  - .7 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .8 ASTM C612, Mineral Fiber Block and Board Thermal Insulation.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
  - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations.
  - .1 Thermal Insulation Association of Canada (TIAC)
  - .2 North American Commercial and Industrial Insulation Standards.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

- .3 Submit completed detail plates from the North American Commercial and Industrial Insulation Standards manual, applicable to installation types required by this specification section.

### **1.3 INSTALLATION INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

### **1.4 QUALIFICATIONS**

- .1 Installer to have successfully completed apprenticeship program.
- .2 Installer to be specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

### **1.6 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.
  - .3 "ASJ+" – All Service Jacket – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper, with outer poly film leaving no paper exposed.
  - .4 "ASJ" – All Service Jacket (no outer film) – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper outer layer.
  - .5 "FSK" – Foil Scrim Kraft – vapor retarder laminate of aluminium foil outer layer, reinforced with fiberglass scrim, bonded to a natural kraft paper inner layer.
- .2 Insulation systems - insulation material, fasteners, jackets, and other accessories.

### **1.7 QUALITY ASSURANCE**

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

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**Part 2            Products**

**2.1            LIMITATION ON MATERIALS**

- .1        Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.
- .2        Materials shall be: **“Certified Asthma and allergy friendly” and “verified Healthy Air.”**

**2.2            FIRE AND SMOKE RATING**

- .1        In accordance with CAN/ULC S102:
  - .1        Maximum flame spread rating: 25.
  - .2        Maximum smoke developed rating: 50.

**2.3            INSULATION**

- .1        Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2        Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C177 or ASTM C518.
- .3        Type C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket meeting the requirement of ASTM C1136 Type II and IV (FSK):
  - .1        Jacket: to ASTM C1136 Type II and IV (FSK)
  - .2        Maximum "k" value: .033 W/M•°C (.23 BTU•IN/HR•FT<sup>2</sup>•°F)
- .4        Type C-2: Mineral fibre blanket to ASTM C553 Type I, II, and III, ASTM C1136 Type II and IV, and ASTM C1290 Type III:
  - .1        Jacket: to ASTM C1136, Type II and IV.
  - .2        Maximum "k" value: 042 W/M•°C (.29 BTU•IN/HR•FT<sup>2</sup>•°F)
- .5        Type C-6: Pipe and tank insulation: Fibreglass segmented board bonded to laminated vapor retarder:
  - .1        Mineral fibre: to ASTM C1393 type II or type IIIA, Category 2.
  - .2        Jacket: ASJ or FSK type
  - .3        Maximum "k" factor: 0.26 BTU • IN/HR • FT<sup>2</sup> • °F (0.037 W/M • °C) or less
- .6        Manufacturers:
  - .1        All materials must be supplied by the same manufacturer.
  - .2        Acceptable Materials:
    - .1        Johns Manville
    - .2        Knauf
    - .3        Manson

## **2.4 JACKETS**

- .1 Canvas:
  - .1 220 g/m<sup>2</sup> (6 oz/sq.yd.) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
  - .2 Lagging adhesive: Compatible with insulation.

## **2.5 ACCESSORIES**

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 g/m<sup>2</sup> (6oz/yd<sup>2</sup>) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .5 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.
- .6 Contact adhesive: quick-setting Childers CP-82 or equal.
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm (16 gauge) stainless steel.
- .9 Facing: 25 mm (1") stainless steel hexagonal wire mesh stitched on one face of insulation
- .10 Fasteners: weld pins, length to suit insulation, with 40 mm (1½") diameter clips.

## **Part 3 Execution**

### **3.1 PRE-INSTALLATION REQUIREMENTS**

- .1 Pressure testing of ductwork systems to be complete, witnessed, and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

### **3.2 INSTALLATION**

- .1 Install in accordance with North American Commercial and Industrial Insulation Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.

- .4 Supports, Hangers in accordance with general requirements.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .5 Fasteners: At 300 mm (12") oc. in horizontal and vertical directions, minimum two rows each side.
- .6 Provide rigid insulation for exposed ductwork.

### 3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses conform to following table:

Application	Type	Thickness
Rectangular supply air ducts	C-1	25 mm (1")
Round supply air ducts	C-2	25 mm (1")
Round supply/exhaust air ducts requiring additional finish/jacket	C-6	25 mm (1")
Supply, return and fan exhaust ducts exposed (visible) in space being served	none	
Energy/Heat Recovery Ventilator Exhaust Ducts & Supply Air Ducts	C-1	25 mm (1")
Outdoor air intake ductwork and plenums	C-1	50 mm (2")
Exhaust plenums dampers and louvres	C-1	25 mm (1")
Interior acoustically lined ducts	none	
Last 1.5m of Exhaust duct	C-1	25 mm (1")
Indoor AHU relief air ducts	C-1	25 mm (1")

- .2 Exposed round ducts 600 mm (24") and larger, smaller sizes where subject to abuse:
  - .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
  - .2 C-6 insulation is also acceptable. Same thickness, schedule, and facing to be used as C-1 material.
- .3 Finishes: Conform to following table:

Application	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed	Canvas	Canvas

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulating Pipes, Vessels, and Round Ducts.
- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM)
  - .1 ASTM C547, Type I and IV Standard Specification for Mineral Fiber Pipe Insulation.
  - .2 ASTM C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
  - .3 ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus to recognize the correct thermal insulation performance testing for blanket.
  - .4 ASTM C1393, Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks
  - .5 ASTM C1695, Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service.
  - .6 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  - .7 ASTM C 921, Practice for Determining the Properties Jacketing Materials for Thermal Insulation.
  - .8 ASTM C1729 Standard Specification for Aluminium Jacketing for Insulation.
  - .9 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .10 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
  - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC)
  - .2 North American Commercial and Industrial Insulation Standards

## **1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit properly completed detail plates from the North American Commercial and Industrial Insulation Standards manual, applicable to installation types required by this specific section.
- .3 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves, and jointing recommendations.

## **1.3 INSTALLATION INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

## **1.4 QUALIFICATIONS**

- .1 Installer to have successfully completed apprenticeship program.
- .2 Installer to be specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather, construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

## **1.6 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.
  - .3 "ASJ+" – All Service Jacket – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper, with outer poly film leaving no paper exposed.
  - .4 "ASJ" – All Service Jacket (no outer film) – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper outer layer.
  - .5 "FSK" – Foil Scrim Kraft – vapor retarder laminate of aluminum foil outer layer, reinforced with fiberglass scrim, bonded to a natural kraft paper inner liner.

- .6 "PSK" – Poly Scrim Kraft – vapor retarder laminate of polypropylene outer layer, reinforced with fiberglass scrim, bonded to a natural kraft paper inner layer.
- .7 "PVC" – Poly Vinyl Chloride – polymer used to manufacture a non-metallic final protective finish jacket over insulation systems.

## **1.7 QUALITY ASSURANCE**

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

## **Part 2 Products**

### **2.1 MATERIAL LIMITATIONS**

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

### **2.2 FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.3 INSULATION**

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C335, ASTM C177 or ASTM C518.
- .3 Type A-1: Rigid moulded or wound mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to ASTM C547 Type I and IV.
  - .2 Jacket: to ASTM C1136, Type I, II, III, IV, X.
  - .3 Maximum "k" factor: to ASTM C547.
- .4 Type A-5: Fiberglass pipe and tank insulation:
  - .1 Segmented, flexible fiberglass board bonded to laminated vapor retarder, ASJ or FSK.
  - .2 Complying with ASTM C1393, Type II or Type III Category 2.
  - .3 Maximum "k" value: 0.037W/M (or less) x C° at 100°F (38°C) (0.26BTU x IN/HR/FT² at 38°C (100°F)
  - .4 Jacket: specified in 'Factory-Applied Jackets' Article

.5 Materials:

- .1 All materials must be supplied by the same manufacturer.
- .2 Acceptable Materials:
  - .1 Knauf
  - .2 Manson
  - .3 Owens Corning

**2.4 INSULATION SECUREMENT**

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm (2") wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 **Tie wire: 1.5mm (16 gauge) diameter stainless steel.**
- .5 **Bands: Stainless steel, 20 mm (3/4") wide, 0.5 mm (0.020") thick.**

**2.5 CEMENT**

- .1 Thermal insulating and finishing cement:
  - .1 Air drying on mineral wool, to ASTM C 449M.
  - .2 Hydraulic setting on mineral wool, to ASTM C165

**2.6 VAPOUR RETARDER LAP ADHESIVE**

- .1 Water based, fire retardant type, compatible with insulation.

**2.7 INDOOR VAPOUR RETARDER FINISH**

- .1 Compatible with insulation.

**2.8 OUTDOOR VAPOUR RETARDER FINISH**

- .1 Compatible with insulation.
- .2 Reinforcing fabric: Open weave fibreglass fabric, with maximum weave of 10 x 10 squares per inch.

**2.9 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 Minimum thickness: 20mil (0.020")
  - .2 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .3 Colours: white.
  - .4 Minimum service temperatures: -29°C (-20°F).
  - .5 Maximum service temperature: 65°C (150°F).
  - .6 Moisture vapour transmission: 0.05 perm.

- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks (not to be used on below-ambient temperature systems)
  - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Aluminum:
  - .1 To ASTM C1729.
  - .2 Thickness: 0.50 mm (0.020") sheet.
  - .3 Finish: Smooth.
  - .4 Joining: Longitudinal and circumferential slip joints with 50 mm (2") laps.
  - .5 Fittings: 0.50 mm (0.020") thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 20 mm (3/4") wide, 0.50 mm (0.020") thick at 300 mm (12") spacing.
- .3 Canvas:
  - .1 220 g/m<sup>2</sup> (6oz/sq yd) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
  - .2 Lagging adhesive: Compatible with insulation.

## **2.10 CAULKING FOR JACKETS**

- .1 Caulking: Silicone clear caulking.

## **Part 3 Execution**

### **3.1 PRE-INSTALLATION REQUIREMENT**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed, and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

### **3.2 INSTALLATION**

- .1 Install in accordance with North American Commercial and Industrial Insulation Standards.
- .2 Provide continuous insulation for complete systems including all valves, air separators, fittings, and other equipment.
- .3 Apply materials in accordance with manufacturers' instructions and this specification.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers:

- .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

**3.3 REMOVABLE, PREFABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: At expansion joints, valves, primary flow measuring elements, flanges, and unions at equipment.
- .2 Flexible removable insulation covers are not acceptable for below-ambient (cold) operation piping systems. Rigid removable insulation jackets that are vapor retarder exterior material that can be vapor sealed at the seams, are acceptable on below-ambient (cold) operation piping systems.
- .3 Insulation:
- .1 Insulation, fastenings, and finishes: same as system.
- .2 Jacket: As per adjacent insulation.

**3.4 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges, air separators, and fittings unless otherwise specified.
- .2 Install insulator and jackets to applicable TIAC codes.
- .3 Insulate ends of capped piping with type and thickness indicated for capped service.
- .4 Thickness of insulation to be as listed in following table.
- .1 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Type	Pipe sizes through (NPS) and insulation thickness mm (")				
		to	32 (1¼")	50 (2")	105 (4")	200 (8")
		25 (1")	40 (1½")	80 (3")	150 (6")	& over
Hot Water Heating	A-1	40 (1½")	50 (2")	50 (2")	50 (2")	50 (2")
Refrigerant piping	A-3	25 (1")	25 (1")	25 (1")	25 (1")	25 (1")

.5 Finishes: Conform to the following table:

Application	Piping	Valves & Fittings
Exposed indoors	PVC	PVC
Exposed in mech. rooms	PVC	PVC
Concealed indoors	N/A	PVC
Within 300 mm (12") of boiler	CANVAS	CANVAS
Exterior refrigerant piping	Aluminum	Aluminum

- .6 Connection: To appropriate TIAC code.
- .7 Finish attachments: SS bands, @ 150 mm (6") oc. seals: closed.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch.
- .3 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .5 ANSI B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
- .6 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
- .7 ASTM A53/A53M, and A106, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded ERW and Seamless.
- .8 ASTM B32, Specification for Solder Metal.
- .9 ASTM B75M, Specification for Seamless Copper Tube [Metric].
- .10 CSA B149.1, Natural Gas and Propane Installation Code.
- .11 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings product data in accordance with general requirements.
- .2 Indicate on manufacturers catalogue literature.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

**Part 2 Products**

**2.1 GAS SERVICE**

- .1 Arrange with the local utility to have the gas service provided from the street to the gas meter where indicated.
- .2 Fees and charges requested by the local utility to provide the gas service and meter.
- .3 Submit all plans as requested by the local utility.
- .4 Utility supplied gas meter shall be complete with pulse signal for connection to BAS system (coordinate pulse representation in m<sup>3</sup> of gas used on meter specifications.
- .5 Where utility cannot supply meter with pulse signal, provide approved pulse gas meter in all locations where indicated on the drawings.



## 2.2 PIPE

- .1 Steel pipe: to ASTM A106, Schedule 40, seamless as follows:
  - .1 NPS 15 mm to 50 mm (1/2" to 2"), screwed.
  - .2 NPS 65 mm (2 1/2") and over, plain end.
- .2 Buried pipe: CGA approved polypropylene complete with tracer wire and marker.
- .3 Copper tube: to ASTM B75M.
- .4 **Flexible gas pipe: ASTM A240 CSA/ULC approved corrugated 304 stainless steel piping to ASTM A240 with UV resistant polyethylene jacket to ASTM E84. Fittings to ASTM B16 Type 360 Brass. Provide end fittings to suit connections.**

## 2.3 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Soldered: to ASTM B32, tin antimony 95/5.
- .5 Screwed brass fittings: Teflon Tape.

## 2.4 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
  - .1 Malleable iron: screwed, banded, Class 150.
  - .2 Steel pipe flanges and flanged fittings: to ANSI/ASME B16.5.
  - .3 Welding: butt-welding fittings.
  - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
  - .5 Bolts and nuts: to ANSI B18.2.1.
  - .6 Nipples: schedule 40, to ASTM A53/A53M/A106.
- .2 Copper pipe fittings, screwed, flanged or soldered:
  - .1 Cast copper fittings: to ANSI B16.18.
- .3 Brass fittings: To ASTM B16.

## 2.5 BALL VALVES

- .1 NPS 50 mm (2") and under:
  - .1 Body and cap: cast high tensile bronze to ASTM B62.
  - .2 Pressure rating: Class 125, 860 kPa (125 psi) steam, WP = 1.4 MPa (203 psi) WOG.
  - .3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders.
  - .4 Stem: tamperproof ball drive.
  - .5 Stem packing nut: external to body.
  - .6 Ball and seat: replaceable stainless steel solid ball and teflon seats.

- .7 Stem seal: TFE with external packing nut.
- .8 Operator: removable lever handle.

## **2.6 LUBRICATED PLUG VALVES**

- .1 All sizes
  - .1 Provincial Code approved, lubricated plug type.
  - .2 Body: cast iron to ASTM A 126 Class B semi-steel.
    - .1 Rating: Class 125 psig.
  - .3 Plug: tapered, with regular pattern port – 90 from full open to fully closed.
  - .4 Ends: 50 mm (2") and smaller with hexagon shoulders, ends screwed to ANSI B1.20.1. Flanged to ANSI B16.1.
  - .5 Lubrication system, nickel-plated.
  - .6 Lubricant: to suit type, temperature and pressure of contained fluid.
  - .7 Feeding system: lubricant forced into lubrication grooves between seating surfaces of plug and body to form positive seal, leakproof operation, and corrosion preventing film.
  - .8 Lubricant screw for lubrication.
  - .9 O-rings between body and plug.
  - .10 Operator: removable manual lever handle.
  - .11 Acceptable materials:
    - .1 Newman Hattersley
    - .2 Crane
    - .3 Jenkins
    - .4 Milwaukee
    - .5 Toya

## **2.7 CONTRACTOR PROVIDED GAS METERS**

- .1 If utility will not provide meter with digital pulse for BAS connection, then this contractor shall provide a gas meter complete with digital pulse for connection to the BAS system for where indicated on the drawings.
- .2 The gas meter shall be compatible with the requirement of the local utility and BAS contractor.
- .3 Acceptable materials: Badger Meter Inc. (Line Process Controls 1-416-291-8525).

## **2.8 GAS REGULATOR**

- .1 Reduce pressure from 34.5 kPa (5 psi) to 1.74 kPa (7" WC) capacity as indicated.
- .2 Acceptable products:
  - .1 Singer
  - .2 Schlumberger

- .3 Vent interior relief valve to outdoors with gooseneck and stainless steel insect screen. Vent piping shall be sized as per manufacturers' requirements and recommendations.
- .4 Isolate with lubricated plug valve and union connection.

## **2.9 EMERGENCY GENERATOR SUPERVISORY VALVE**

- .1 This contractor shall be responsible for all supervisory switches serving emergency generator natural gas piping.
- .2 All valves between the gas meter and emergency generator require electric supervision back to the generator control panel.
- .3 This contractor responsible for supply, install, and wiring of valve and supervisory switch for gas valves between the meter assembly and the generator system.
  - .1 Acceptable manufacturers:
    - .1 Potter PTS-C or equal.
- .4 Utility grade position indicating valve shall be supplied by local utility. This contractor shall coordinate fully with local utility and pay all fees as required for supply valve, and the contractor shall complete the installation of valve and supervisory operator. All wiring by mechanical contractor.
  - .1 Floating stainless steel ball valve, full port, quarter turn with power stops and 2" square operating nut. End configuration raised face flange X raised face flange.
    - .1 Acceptable manufacturer:
      - .1 Broan Ballomax.
  - .2 Valve top, discrete valve controller with bus networking pilot valve, and position sensors, explosion proof. Die-cast enclosure, complete with standard 90° green open, red closed visual display.
    - .1 Acceptable manufacturer:
      - .1 Topworx valve top DXP.

## **Part 3 Execution**

### **3.1 PIPING**

- .1 Install in accordance with applicable Provincial/Territorial Codes.
- .2 Install in accordance with CAN/CSA B149.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .5 Slope piping down in direction of flow to low points.
- .6 Install drip points:
  - .1 At low points in piping system.
  - .2 At each connection to equipment.

- .7 Use eccentric reducers at pipe size change installed to provide positive drainage.
- .8 Provide clearance for access and for maintenance.
- .9 Ream pipes, clean scale and dirt, inside and out.
- .10 Install piping to minimize pipe dismantling for equipment removal.
- .11 Install regulator vents to code. Terminate in open air with Gooseneck fitting complete with stainless steel screen.
- .12 Paint gas piping with two (2) coats yellow paint. Banding of gas will not be accepted.

### **3.2 VALVES**

- .1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.
- .2 Install valves at branch take-offs to isolate each piece of equipment, and as indicated.
- .3 Provide lubricated plug type when gas line is exterior of building or 65 mm (2½") and larger.
- .4 Provide ball valve when gas line is interior of building and 50 mm (2") or smaller.

### **3.3 SUPERVISORY SWITCH**

- .1 Install on valves as indicated to monitor open/closed position of valve and send signal to fire alarm system. Install to manufacturer's recommendations.

### **3.4 FIELD QUALITY CONTROL**

- .1 Test system in accordance with CAN/CSA B149. Requirements of authorities having jurisdiction.
- .2 Provide copy of TSSA tag to the consultant.

### **3.5 PURGING**

- .1 Purge after pressure test in accordance with CAN/CSA B149.

### **3.6 GAS SERVICE**

- .1 Arrange with local gas distributor to install gas service and gas meter. Pay all fees and charges to provide the gas service and gas meter.
- .2 Install all the gas meters where indicated.

### **3.7 GAS FIRED EQUIPMENT START-UP**

- .1 Start-up of all new and existing gas fired equipment shall be by this contractor to the requirements of the equipment manufacturer.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian Standards Association (CSA).
  - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .3 American Society for Testing and Materials (ASTM).
  - .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A278/A278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F (350°C).
  - .3 ASTM A516/A516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .4 ASTM A536, Specification for Ductile Iron Castings.
  - .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME, Boiler and Pressure Vessels Code (BPVC).

### **1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate on manufacturers' catalogue literature the following:
  - .1 Sizes, orientation, capacities, performance, etc.
  - .2 Accessories

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

## **Part 2 Products**

### **2.1 CLOSED EXPANSION TANK**

- .1 Horizontal expansion tank with threaded pipe connections.
- .2 Quantity, size, and capacity as shown on the drawings.
- .3 Construction:
  - .1 ASME code rated welded tank to 860 kPa (125 psi) test pressure of ASTM A516/A516M, pressure vessel carbon steel plate with dished heads galvanized after manufacture.

- .2 Conform to: ANSI/ASME BPVC, Section VIII and CSA B51, and provincial regulations.
- .3 Submit certificate of registration as required by [provincial authorities].
- .4 Accessories:
  - .1 Expansion pipe connection at bottom.
  - .2 NPS 25 mm (1") drain connection at bottom with drain valve.
  - .3 Vent connection, NPS 25 mm (1"), at top.
  - .4 Relief valve and connection at top, to manufacturer's recommendations.
  - .5 15 mm (1/2") sight glass connections at 1/8 and 7/8 points of height, complete with sight glass, shut-off valves with blowdown and protective guards.
  - .6 Two - 65 mm (2 1/2") inspection tapings on centre line of sides, one near each end.
- .5 Acceptable Manufactures:
  - .1 Bell and Gossett
  - .2 Armstrong
  - .3 Clemmer

## **2.2 BLADDER TYPE EXPANSION TANK**

- .1 Vertical galvanized steel pressurized bladder type expansion tank.
- .2 Quantity, size, and capacity as shown on the drawings.
- .3 Working pressure: 860 kPa (125 psi) with ASME stamp and certification.
- .4 Air precharged to 84 kPa (12 psi) (initial fill pressure of system).
- .5 Base mount for vertical installation.
- .6 Acceptable materials:
  - .1 Amtrol
  - .2 Armstrong
  - .3 Bell & Gossett

## **2.3 AIR SEPARATOR BOILER MOUNTED**

- .1 Complete with dip tube.
- .2 Working pressure: 860 kPa (125 psi).

## **2.4 AIR SEPARATOR EXPANSION TANK FITTING**

- .1 Complete with adjustable vent tube and built-in manual vent valve.
- .2 Working pressure: 860 kPa (125 psi).

## **2.5 AIR SEPARATOR IN-LINE**

- .1 Size: line size as indicated.

## **2.6 COMBINATION SEPARATORS STRAINERS**

- .1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 860 kPa (125 psi) operating pressure, with galvanized steel integral strainer with 5 mm (3/16") perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.
- .2 Size: to match piping.
- .3 Acceptable material:  
To be of the same manufacturer of base mounted pumps.

## **2.7 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE**

- .1 Adjustable pressure setting: 206 kPa (30 psi) relief, 55 to 172 kPa (8.0 to 25 psi) reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

## **2.8 PIPELINE STRAINER**

- .1 Pipeline strainer shall provide a means of mechanically removing solids from a flowing fluid. This is accomplished by utilizing a perforated metal mesh.
- .2 Strainers shall be installed in pipelines to protect downstream mechanical equipment such as condensers, heat exchangers, pumps, compressors, meters, spray nozzles, turbines, and steam traps from the detrimental effect of sediment, rust, pipe scale, or other extraneous debris.
- .3 Types of strainers: Provide strainers that are Y strainer and/or basket strainer.
- .4 Strainer end connections shall match the piping specification.
  - .1 NPS 15 mm to 50 mm (1/2" to 2"): bronze body to ASTM B62, screwed connections.
  - .2 NPS 65 mm to 300 mm (2 1/2" to 12"): cast steel body to ASTM A278M, Class 30, flanged connections.
  - .3 NPS 50 mm to 300 mm (2" to 12"): T type with malleable iron body to ASTM A47M, grooved ends.
- .5 Strainer components shall include a cover, perforated plate, mesh, wedge wire, gasket, and cover fasteners.
  - .1 Perforated Plate/Mesh/Wedge Wire: Stainless steel (various grades available).
  - .2 Gaskets: to suite fluid application.
  - .3 Fasteners: to match body material.

- .6 Mesh sizing: An extremely important consideration in the selection of a strainer is the size of the perforations, mesh or wire opening used in the fabrication of the straining element. Select holes that are actually needed for the application and specified by the equipment manufacturer's request that is being protected. The following tables illustrate mesh and their respective straining capability. The main criteria for choosing hole and mesh size is the size and quantity of particles which can pass through downstream equipment without causing damage.

Mesh (Openings/In.)	Wire Diameter (In.)	Opening		Percent Open Area
		Inches	Micron	
10	0.032	0.068	727	56.3
16	0.018	0.045	1130	50.7
18	0.017	0.036	979	48.3
20	0.015	0.035	889.0	49.0
30	0.011	0.0223	566.4	44.8
40	0.009	0.0156	396.2	40.2
50	0.009	0.011	279	30.3
60	0.0065	0.0102	259.1	37.3
80	0.005	0.0075	190.5	36.0
100	0.0045	0.0055	139.7	30.3
120	0.0035	0.0048	123	30.1
150	0.0026	0.0041	103	37.2
170	0.0024	0.0035	79	35.1
200	0.0020	0.0030	76.2	33.6
250	0.0016	0.0024	61	36.0
300	0.0012	0.0021	54.2	29.7
325	0.0012	0.0019	47.7	30.0
400	0.0011	0.0014	35.6	36.0

- .7 Capacity: The capacity ratio or open area ratio (OAR) of a strainer influences such operating characteristics as the length of time it can operate without cleaning and the created pressure loss. The OAR is the relationship between internal cross sectional area (flow area) of the pipe and the open flow area of the material which makes up the straining element.
- The OAR for wye strainers shall not be less than 2.5:1.
- The OAR for basket strainers shall not be less than 7:1.
- When considering the OAR of a straining element, there are two accepted methods of analysis used by various specifying agencies and manufacturers. One method maintains "line of sight" reasoning and uses the multiple of the open areas for elements in series. In this method, a 60% open area material in series with a 40% open area material has a resultant combined open area of 24% (i.e. as in accordance with Military Standards). An alternative method allows the open area of the more restrictive element in series to be used. This would be 40% for the example above (i.e. as in accordance with Underwriter Laboratories' Standards). The method used influences the estimated operating pressure drop, as well as design decisions such as sizing.



- .8 Strainers are made with various dimensions and configurations; manufacturers have tested and published pressure drop results.  
Provide strainers designed for reasonable velocities that permit approximately 2 psi pressure drop across the strainer.  
Provide basket strainers designed for reasonable velocities that permit approximately 0.5 psi pressure drop across the strainer.
- .9 To allow the manufacturer to make selection or recommendations for a particular strainer, as much as possible, the following information should be provided by the Contractor to the Supplier:
  - .1 Physical Characteristics
    - .1 Pipe size and schedule
    - .2 Strainer type required.
    - .3 End connections.
    - .4 Material (body, screen, bolting, gaskets).
    - .5 Pressure rating (design/operating — including shock).
    - .6 Temperature rating (design, operating, minimum).
    - .7 Straining element opening size.
    - .8 Capacity:
      - .1 Net effective open area required.
      - .2 Method of net open area calculation.
    - .9 Special requirements (hinged cover, vent tapping, jacketed, etc.).
    - .10 Applicable specifications (military specifications, special nondestructive tests or other quality control requirements).
  - .2 Flow Data
    - .1 Liquid:
      - .1 Description of fluid.
      - .2 Rate of flow – gallons per minute (gpm) or pounds per hour (lbs/hr).
      - .3 Viscosity – SSU.
      - .4 Specific gravity or density.
      - .5 Temperature.
      - .6 Concentration (if acid or other corrosive).
    - .2 Gas:
      - .1 Description of Gas.
      - .2 Rate of flow – standard cubic feet per minute (scfm) or actual cubic feet per minute (cfm).
      - .3 Specific gravity.
      - .4 Temperature and pressure.
      - .5 Molecular weight.
      - .6 State of flow.

- .10 Blowdown connection: NPS 25 mm (1").
- .11 Screens at pumps: stainless steel with 1.19 mm (50 mil) perforations (16 mesh).
- .12 Working pressure: 860 kPa (125 psi).

## **2.9 LOW WATER CUT-OFF**

- .1 Packaged low water cut-off with heavy duty construction, 16A relay.
- .2 Operates on 24V AC, or 120V switching capacity: 5.8 FLA, 24.8 LRA, Max load: 16A, switch contacts: SPDT, 250 psi max pressure, 250°F max water temperature.
- .3 Burner circuit locks out, if water remains below probe for 30 s. Manual reset will not trip due to power failure.
- .4 Burner circuit test button.
- .5 Indicator lights for troubleshooting.
- .6 Acceptable manufacturer:
  - .1 Hydro Level Company Safgard 500 or 550.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines (and blow off connections) to terminate above nearest drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request, and follow Consultant's directive.
- .5 Check shop drawings for conformance of all tapings for ancillaries and for equipment operating weights.

### **3.2 STRAINERS**

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead each of the following components:
  - .1 Pumps
  - .2 Temperature control valves
  - .3 Condensers
  - .4 Boilers
  - .5 Brazed plate heat exchanger
  - .6 Compressors

- .7 Meters
- .8 Spray nozzles
- .9 Additional locations where indicated on the drawings.
- .4 Provide proper mesh strainers for the proper application.
- .5 Provide proper mesh strainers as recommended by the manufacturer's product being protected.
- .6 Provide basket strainers ahead of all plate heat exchanger or equipment with plate heat exchanger when piping is 100 mm (4") and larger.
- .7 The strainer must be installed such that the debris chamber is located at the lowest possible position. A Y strainer in vertical piping must be placed with its screen in the downward position to trap the sediment in the debris collection chamber.
- .8 Provide with a blowdown so the element can be flushed out by opening and closing the blowdown valve. This shall be accomplished without flow stoppage or disassembling any piping.

### **3.3 EXPANSION TANKS**

- .1 Adjust expansion tank pressure to suit system pressure at installed location or noted design pressure. Where discrepancies between plans and system pressure exist notify consultant.
- .2 Set pressure in accordance with ASME Boiler and Pressure Vessel Code.
- .3 Ensure boiler temperature and pressure relief is adequate for system at high temperature and pressure. Test operation on site.
- .4 Maintain a minimum of 105 kpa (15 psig) as the lowest pressure point.
- .5 Install isolation ball valve and union at inlet to tank.

### **3.4 PRESSURE SAFETY RELIEF VALVES**

- .1 Run discharge pipe to terminate above nearest drain.

### **3.5 AIR SEPARATOR**

- .1 Provide independent support from structure.
- .2 Provide high capacity air vent as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian Standards Association (CSA).
  - .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .3 American National Standards Institute (ANSI).
  - .1 ANSI/ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
  - .2 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.
  - .3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS½ through NPS24 Metric/Inch.
  - .4 ANSI/ASME B16.9, Factory-Made Wrought Steel Butt welding Fittings.
  - .5 ANSI B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
  - .6 ANSI/ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
  - .7 ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 American Society for Testing and Materials (ASTM).
  - .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM A536, Specification for Ductile Iron Castings.
  - .4 ASTM B61, Specification for Steam or Valve Bronze Castings.
  - .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.

- .2 Indicate on manufacturers' catalogue literature the following:
  - .1 Piping
  - .2 Valves
  - .3 Accessories

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

## **Part 2 Products**

### **2.1 STEEL PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 NPS 150 mm (6") and smaller: Schedule 40
- .2 Final connection to copper heating elements.
  - .1 Type "L" copper with 95/5 solder joints and dielectric couplings. Maximum length 600 mm (24").
- .3 Pipe Joints
  - .1 NPS 50 mm (2") and under: screwed fittings with pulverized lead paste.
  - .2 NPS 65 mm (2½") and over: welding fittings and flanges to CSA W47.1.
  - .3 Flanges: plain or raised face, slip-on.
  - .4 Flange gaskets: suitable for hydronic heating up to 110°C (220°F).
  - .5 Pipe thread: taper.
  - .6 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
- .4 Fittings
  - .1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
  - .2 Pipe flanges and flanged fittings:
    - .1 Cast iron: to ANSI/ASME B16.1, Class 125.
    - .2 Steel: to ANSI/ASME B16.5.
  - .3 Butt-welding fittings: steel, to ANSI/ASME B16.9.
  - .4 Unions: malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3.

### **2.2 VALVES**

- .1 Connections:
  - .1 NPS 32 mm (1 1/4") and smaller: screwed ends.
  - .2 NPS 50 mm (2") and smaller: screwed ends.
  - .3 NPS 65 mm (2 ½") and larger: flanged ends.

- .2 Gate valves: Application: Isolating equipment, control valves, pipelines:
  - .1 NPS 50 mm (2") and under:
    - .1 Mechanical Rooms: Class 125, rising stem, solid wedge disc.
    - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc.
  - .2 NPS 65 mm (2 1/2") and over:
    - .1 Mechanical Rooms:
      - .1 Rising stem, solid wedge disc, bronze trim.
        - .1 Operators: handwheel.
      - .2 Non-rising stem, solid wedge disc, bronze trim.
        - .1 Operators: handwheel.
- .3 Butterfly valves: Application: Isolating each cell or section of multiple component equipment and where indicated.
  - .1 NPS 32 mm (1 1/4") and smaller: screwed ends.
  - .2 NPS 50 mm (2") and smaller: screwed ends.
  - .3 NPS 65 mm (2 1/2") and over: Flanged ends.
- .4 Globe valves: Application: Throttling, flow control, emergency bypass:
  - .1 NPS 50 mm (2") and under:
    - .1 With PTFE disc, as specified. Bronze.
  - .2 NPS 65 mm (2 1/2") and over:
    - .1 With solid bronze disc, bronze trim, cast iron body.
- .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, with chain and cap.
- .6 Swing check valves:
  - .1 NPS 50 mm (2") and under:
    - .1 Class 150, swing, with PTFE disc, as specified. Bronze. Jenkins 4475TJ.
  - .2 NPS 65 mm (2 1/2") and over:
    - .1 Flanged, Bronze trim, Cast Iron: Gate, Globe, Check.
- .7 Ball valves:
  - .1 NPS 80 mm (3") and under:
    - .1 Body and cap: cast high tensile bronze to ASTM B62.
    - .2 Pressure rating: Class 125, 860 kPa (125 psi) steam, WP = 1.4 MPa (203 psi) WOG.
    - .3 Connections:
      - .1 NPS 50 mm (2") and under screwed ends to ANSI B1.20.1 and with hex. shoulders.
      - .2 NPS 65 mm (2 1/2") and over flanged ends.
    - .4 Stem: stainless steel tamperproof ball drive.
    - .5 Ball and seat: replaceable stainless steel solid ball and teflon seats.
    - .6 Operator: removable lever handle.

- .7 Extended handles on chilled water valves.
  - .8 Full port.
- .8 All valves shall be of commercial grade and of same manufacturer.
- .9 Acceptable Manufacturers:
  - .1 Newman Hattersley Canada Ltd.
  - .2 Jenkins/Crane
  - .3 Milwaukee
  - .4 Toyo
  - .5 Kitz

### **2.3 BALANCING VALVES**

- .1 Size 15 mm (1/2") to 50mm (2"): Bronze body, brass ball, NPT connections and variable orifice.
- .2 Size 65 mm (2 1/2") to larger: Cast iron body, raised flange connections, glove style with brass plug.
- .3 Differential pressure readout ports with internal EPT inserts and check valves, 6 mm (1/4")NPT tapped drain/purge ports, memory stop and calibrated nameplate.
- .4 Acceptable materials:
  - .1 Bell & Gossett Circuit Setters
  - .2 Armstrong
  - .3 Taco
  - .4 Tour & Anderson
  - .5 Oventrop

### **2.4 TRIPLE DUTY VALVE**

- .1 Straight pattern, combination check, throttling shut off and calibrated balancing valve, heavy duty cast iron construction with standard 125 psig ANSI flanged connections rated for maximum working pressure of 175 psig at 250°F.
- .2 Valve shall be fitted with a replaceable bronze disk with EPDM seat insert, stainless steel stem and chatter preventing spring. Valve design shall permit replacing under full system pressure.
- .3 Valve shall be equipped with brass readout valves (with integral check valves).
  - .1 Acceptable material
    - .1 Bell & Gossett
    - .2 Armstrong

### **2.5 AUTOMATIC AIR VENT**

- .1 Industrial float vent: cast iron body and NPS 15 mm (1/2") connection and rated at 860 kpa (125 psi) working pressure.
- .2 Float: solid material suitable for 115°C (240°F) working temperature.

.3 Plastic vents are not acceptable.

.4 Acceptable materials:

.1 Maid-O-Mist No. 67

.2 Spirax Sarco

## **2.6 PRE-ASSEMBLED COIL KITS**

.1 Ball valve/strainer/drain assembly: cast brass blowout proof stem, Teflon packing, plated ball, strainer-blowdown. Strainer has 20 mesh stainless steel screen, removable. Assembly has temp/pressure port and extra port/plugged) on top. Rated up to 400 psi (2760 kPa) and 110°C (230°F).

.2 Coil hoses: Stainless steel braided exterior, synthetic polymer core hose and stainless ferrules. Rated to 110°C (230°F).

.3 Union/Port fitting: Cast brass with EPDM O-ring, complete with side temp/pressure port, manual air vent on top and union fitting. Rated for 400 psi (2760 kPa) and 110°C (230°F).

.4 ATC: temperature control valve supplied by BAS contractor and turned over to manufacturer for assembly into coil kit. 2-way or 3-way as indicated.

.5 Balancing valve: A metal copper alloy body bonnet, stem and restriction cone. EPDM O-ring union seal and seat seal, with plastic handwheel.  
Two pressure measuring ports for accurate setting. Handwheel range from 4 turns to 22 turns with locking tamperproof setting. Rated from -20°C to 180°C (-4 to 250°F).

.6 Bypass (for TCV & coil bypass): Provide additional, 3rd hose and ball valve/union assembly.

.7 Components to be factory assembled and tested.

.8 Strainer/ball valve/drain on coil inlet.

Union/Port fitting, ATC, balancing valve on coil outlet.

.9 Acceptable manufacturer:

.1 Victaulic Koil Kit

.2 Nexus

## **Part 3 Execution**

### **3.1 PIPING INSTALLATION**

.1 Installation shall be by a licensed pipe fitter.

.2 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.3 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.



- .4 Slope piping in direction of drainage and for positive venting.
- .5 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .7 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
- .8 Assemble piping using fittings manufactured to ANSI standards.
- .9 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

### **3.2 VALVE INSTALLATION**

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install butterfly valves on chilled water and condenser water lines only.
- .3 Install gate or ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .4 Install globe valves for balancing and in by-pass around control valves as indicated.
- .5 Provide silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .6 Provide swing check valves in horizontal lines as indicated.
- .7 Install chain operators on valves NPS 65 mm (2½") and over where installed more than 2400 mm (96") above floor in Boiler Rooms and Mechanical Equipment Rooms.
- .8 Provide ball valves for glycol service.

### **3.3 AIR VENTS**

- .1 Install at high points of systems.
- .2 Install ball valve on automatic air vent inlet.
- .3 Extend vent lines in Mechanical Room with screwdriver stop at 1.8 m AFF.

### **3.4 CIRCUIT BALANCING VALVES**

- .1 Install flow measuring stations and flow balancing valves as indicated.
  - .1 On return side of all heating devices (convectors, panels, force flows, radiation, coils, etc.).
  - .2 On return side of all water or glycol cooling coils.
  - .3 On return side of all reverse return piping loops and/or branch circuits.

- .2 Install to manufacturers requirements.
- .3 Minimum valve size shall be one pipe size smaller than piping or 20 mm ( $\frac{3}{4}$ " ), whichever is larger.
- .4 Refer to Testing Adjusting and Balancing Section for applicable procedures.

### **3.5 FILLING OF SYSTEM**

- .1 Refill system with clean water adding water treatment as specified.
- .2 Coordinate filling of system with HVAC water treatment contractor.

### **3.6 TESTING**

- .1 Test system in accordance with Mechanical General Requirements Section.

### **3.7 FLUSHING AND CLEANING**

- .1 Scope: all new system piping.
- .2 Refer to Water Treatment Section
- .3 Procedure:
  - .1 Flushing and cleaning should only take place after successful piping pressure testing.
  - .2 Terminal device (reheat coils, heat pumps, perimeter radiation, etc.), air handling unit coils and their associated control and balancing valves should be bypassed during the preliminary flushing and cleaning process.
  - .3 Instruments such as flow meters, flow metering valves and orifice plates should only be installed after flushing and cleaning.
- .4 Timing:
  - .1 The overall construction schedule identifies piping flushing and cleaning with realistic time allotments.
  - .2 The mechanical contractor is required to provide a detailed report outlining the processes and procedures for flushing and cleaning per piping system at least 4 to 6 weeks in advance of work.
  - .3 As a minimum, at least one piping flushing and cleaning procedure shall be witnessed, by the consultant and/or commissioning agent.
- .5 The mechanical contractor shall to utilize a qualified water treatment specialist to supervise the flushing and cleaning process and provide the certified water analysis report certifying that the piping systems are clean.
- .6 Coordinate flushing and cleaning of mechanical systems with HVAC water treatment contractor and HVAC systems commissioning contractor.
- .7 Flush and clean new piping system in presence of Consultant.
- .8 Flush after pressure test for a minimum of 4 hrs.
- .9 Fill system with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hrs.

- .10 Thoroughly flush all new mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.
- .11 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
- .12 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.
- .13 Drainage to include drain valves, dirt pockets, strainers, every low point in system.
- .14 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .15 Re-install strainer screens/baskets only after obtaining Consultant's approval and approval from HVAC water treatment contractor.
- .16 Repeat system drain and flush as often as necessary to have a clean system.
- .17 Disposal of cleaning solutions to be approved by authority having jurisdiction.
- .18 Isolate new piping system from existing system as required for system cleaning.
- .19 After hydronic system is cleaned, refill with clean water and chemical as per chemical supplier treatment.

**END OF SECTION**

**Part 1            General**

**1.1                SHOP DRAWINGS AND PRODUCT DATA**

- .1      Submit shop drawings and product data in accordance with General Requirements.
- .2      Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories, and controllers.
- .3      Submit product data of pump curves for review showing point of operation.
- .4      Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

**1.2                MAINTENANCE DATA**

- .1      Provide maintenance data for incorporation into manual specified in general requirements.

**Part 2            Products**

**2.1                IN-LINE CIRCULATORS**

- .1      Volute: bronze radially split, with screwed or flanged design suction and discharge connections.
- .2      Impeller: bronze.
- .3      Shaft: alloy steel with copper sleeve bearing, integral thrust collar.
- .4      Seal assembly: mechanical for service to 135°C (275°F).
- .5      Coupling: flexible self-aligning.
- .6      Motor: resilient mounted, drip proof, sleeve bearing, as indicated.
- .7      Capacity: as indicated.
- .8      Design pressure: 1207 kPa (175 psi).
- .9      Acceptable material:
  - .1      Bell & Gossett Model
  - .2      Armstrong
- .10     Motor: resilient mounted, drip proof, sleeve bearing, as indicated
- .11     Capacity: as indicated.
- .12     Design pressure: 1200 kPa (175 psi).

- .13 Acceptable material:
  - .1 Grundfos
  - .2 Bell & Gossett Model
  - .3 Armstrong
  - .4 Darling

## **2.2 SPARE PARTS**

- .1 Refer to Section 23 05 11 General HVAC Work Requirements.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible suction discharge in vertical alignment.
- .2 Base mounted type: supply templates for anchor bolt placement. Furnish anchor bolts with sleeves. Place level, shim unit and grout. Align coupling in accordance with manufacturer's recommended tolerance. Check oil level and lubricate. After run-in, tighten glands.
- .3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to floor drain complete with isolating valve.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge with plug cocks on inlet and outlet on pump.

### **3.2 TRIPLE DUTY VALVES**

- .1 Valves shall be straight pattern.
- .2 Provide 4x pipe diameter spool piece between pump discharge and triple duty valve.
- .3 Leave valves open for T.A.B to set.

### **3.3 INLINE PUMPS**

- .1 Install all inline pumps with isolation valves, inlet strainers, reducers/increasers, and pressure gauges on both sides.

### **3.4 PUMP INSTALLATION**

- .1 Install pumps to manufacturer's recommendation.

### **3.5 PUMP VIBRATION**

- .1 Install pumps isolated from the piping system when larger than 2" piping main.

- .2 Install pumps on vibration isolators and flex connectors when greater than 3.0 HP.
- .3 Install pumps on an inertia pad when on an upper floor level and 3.0 HP or greater.  
Pumps mounted on slab, on grade, for 3.0 HP or greater can be on spring isolator base.
- .4 All pumps 15 HP and greater shall be installed on inertia base regardless of location in building.

### **3.6 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B16.22, Wrought Copper Alloy and Copper Alloy Solder - Joint Pressure Fittings: Classes 150, 300, 600, 900, 1500, and 2500.
- .3 ANSI/ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings.
- .4 ANSI/ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
- .5 ANSI/ASME B31.5, Refrigeration Piping and Heating Transfer Components.
- .6 ASTM A307, Specification for Carbon Steel Bolts and Studs, 413.5 mPa (60,000 psi) Tensile Strength.
- .7 ASTM B280, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .8 CSA B52, Mechanical Refrigeration Code.
- .9 EPS 1/RA/2, Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

**Part 2 Products**

**2.1 TUBING**

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
  - .1 Hard copper: to ASTM B280, Type ACR-B.
  - .2 Soft copper: to ASTM B280, Type ACR
  - .3 Refer to Part 3 for allowed applications.

**2.2 FITTINGS**

- .1 Service: design pressure 2070 kPa (300 psi) and temperature 121°C (250°F).
- .2 Brazed:
  - .1 Fittings: wrought copper to ANSI/ASME B16.22.
  - .2 Joints: silver solder, 45% Ag-15% Cu or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
- .3 Flanged:
  - .1 Bronze or brass, to ANSI/ASME B16.24, Class 150 and Class 300.
  - .2 Gaskets: suitable for service.
  - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .4 Flared:
  - .1 Bronze or brass, for refrigeration, to ANSI/ASME 16.26.

## **2.3 PIPE SLEEVES**

- .1 Hard copper or steel, sized to provide 6 mm (1/4") clearance all around between sleeve and uninsulated pipe or between sleeve and insulation.

## **2.4 VALVES**

- .1 22 mm (7/8") and under: Class 500, 3.5 MPa (500 psi), globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm (7/8"): Class 375, 2.5 MPa (375 psi), globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## **2.5 FILTER-DRIER**

- .1 On lines 20 mm (3/4") outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
- .2 On lines smaller than 20 mm (3/4") outside diameter, filter-drier shall be sealed type using flared copper fittings.
- .3 Size shall be full line size.
- .4 Approved manufacturers:
  - .1 As approved by equipment manufacturer
  - .2 Mueller
  - .3 Parker
  - .4 Sporlan
  - .5 Virginia

## **2.6 SIGHT GLASS**

- .1 Combination moisture and liquid indicator with protection cap.
- .2 Sight glass shall be full line size.
- .3 Sight glass connections shall be solid copper or brass, no copper-coated steel sight glasses allowed.
- .4 Approved manufacturers:
  - .1 As approved by equipment manufacturer
  - .2 Mueller
  - .3 Henry
  - .4 Parker
  - .5 Superior

## **2.7 SUCTION LINE TRAP**

- .1 Manufactured standard one-piece traps.



## **2.8 EXPANSION VALVES**

- .1 For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
- .2 Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
- .3 Approved manufacturers:
  - .1 As approved by equipment manufacturer
  - .2 Henry
  - .3 Mueller
  - .4 Parker
  - .5 Sporlan

## **2.9 FLEXIBLE CONNECTORS**

- .1 Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
- .2 Approved manufacturers:
  - .1 As approved by equipment manufacturer
  - .2 Anaconda "Vibration Eliminators" by Anamet
  - .3 Vibration Absorber Model VAF by Packless Industries
  - .4 Vibration Absorbers by Superior Valve Co
  - .5 Style "BF" Spring-flex freon connectors by Vibration Mountings.

## **2.10 WALL FLASHING**

- .1 Thaler or equal spun aluminum complete with insulation, cap, and rubber gasket.

## **2.11 PIPING SUPPORT ASSEMBLY**

- .1 All channel members shall be fabricated from structural grade steel conforming to one of the following ASTM specifications: A1011/A1011M, A653/A653M.
- .2 All fittings shall be fabricated from steel conforming to one of the following ASTM specifications: A575, A36/A36M or A635/A635M.
- .3 Electro galvanized cush clamps with shoulder bolt and molded thermoplastic cushion, size to suit pipe.
- .4 Acceptable materials:
  - .1 Unistrut
  - .2 Or equal

**Part 3 Execution**

**3.1 GENERAL**

- .1 Install in accordance with CSA B52, EPS 1/RA/2 and ANSI/ASME B31.5.
- .2 Connect to equipment with isolating valves and unions.
- .3 Provide space for servicing, disassemble, and removal of equipment and components all as recommended by manufacturer.
- .4 Protect all openings in piping against entry of foreign material.
- .5 Provide all necessary equipment including thermal expansion valve, sight glass, solenoid valve, filter dryer, etc., for a complete installed system. Pipe system as per manufacturer's recommendation and requirements.
- .6 Provide number of refrigerant circuits and appropriate corresponding piping as per manufacturer's recommendations and requirements.

**3.2 APPLICATION**

- .1 Soft copper piping is allowed to be used as follows:
  - .1 For all systems under 3 tons in nominal size, except for exterior piping.
- .2 Hard Copper shall be used as follows:
  - .1 For all other systems/applications.
  - .2 For all exterior piping.

**3.3 PIPING THROUGH FLOORS**

- .1 Refrigerant piping systems containing refrigerants that pass through floors not served by the system shall be installed as per the requirements of CSA B23-2023:
  - .1 Refrigerant piping shall be installed through a rigid and tight, continuous fire-resisting pipe (stainless steel, cast iron or similar) without openings into any floors not served by the system.
  - .2 The pipe shall be vented to the floor served by the system.
  - .3 Soft copper may be used when the shaft extends beyond two (2) storeys in length.

**3.4 BRAZING PROCEDURES**

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

### **3.5 PIPING INSTALLATION**

- .1 General:
  - .1 Hard drawn copper tubing: do not bend. Minimize use of fittings.
  - .2 Soft drawn copper: install in a neat manner without excessive bends or twists. Minimize use of fittings.
  - .3 Fittings, joints and other connections to equipment shall be minimized in all inaccessible areas, including but not limited to areas above drywall ceilings, shafts etc.
  - .4 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
  - .5 Provide trap at base of risers greater than 2.4 m (8') high and at each 7.6 m (25'-0") thereafter.
  - .6 Provide inverted deep trap at top of each riser.
  - .7 Provide double risers for compressors having capacity modulation.
    - .1 Large riser: install traps as specified above.
    - .2 Small riser: size for 5.1 m/s (1000 ft/min) at minimum load. Connect upstream of traps on large riser.

### **3.6 PRESSURE AND LEAK TESTING**

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2 MPa (290 psi) and 1 MPa (145 psi) on high and low sides respectively.
- .3 Test Procedure: Build pressure up to 35 kPa (5 psi) with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.
- .4 Testing shall be completed to the standards of CSA B52, section 5.10 so that the exemption contained in Annex N (N.1.2) allowing areas (such as those above fully enclosed drywall ceilings) to have joints and connections installed within them is met.

### **3.7 DEHYDRATION AND CHARGING**

- .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13°C (55°F) for at least 12 h before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use 2-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa (0.02" WC) absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

- .6 Triple evacuate all system components containing gases other than correct refrigerant or having lost holding charge as follows:
  - .1 Twice to 14 Pa (0.056" WC) absolute and hold for 4 h.
  - .2 Break vacuum with refrigerant to 14 kPa (0.056" WC).
  - .3 Final to 5 Pa (0.02" WC) absolute and hold for at least 12 h.
  - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
  - .5 Submit all test results to Consultant.
- .7 Charging:
  - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
  - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
  - .1 Make all checks and measurements as per manufacturer's operation and maintenance instructions.
  - .2 Record and report all measurements to Consultant.

### **3.8 INSTRUCTIONS**

- .1 Post instructions in frame with glass cover in accordance with Operation and Maintenance Manual Section and CSA B52.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED SECTIONS**

- .1      Plumbing Specialties and Accessories.
- .2      Hydronic Systems – Steel.

**1.2            REFERENCES**

- .1      All codes, standards, etc. as referenced shall be the latest edition.
- .2      American Society of Mechanical Engineers (ASME).
- .3      ANSI/ASME Boiler and Pressure Vessel Code, Section VI.

**1.3            SHOP DRAWINGS AND PRODUCT DATA**

- .1      Submit shop drawings and product data in accordance with general requirements.

**1.4            CLOSEOUT SUBMITTALS**

- .1      Submit operation and maintenance data for incorporation into manual specified in general requirements
- .2      Include following:
  - .1      Log sheets as recommended by manufacturer.
  - .2      Test reports.

**Part 2           Products**

**2.1            MANUFACTURER**

- .1      Equipment, chemicals, service by one supplier.
- .2      Acceptable manufacturer:
  - .1      Magnor Inc.
  - .2      Magnus Industrial Treatment Solutions Inc.
  - .3      Chem Aqua (226-808-3617)
  - .4      D.H. Jutzi Limited (519-271-9831)
  - .5      Control Chem Canada Ltd.
  - .6      Rochester Midland Corporation (905-619-6738)
  - .7      Aquarian Chemicals (905-825-3711).

**2.2            POT FEEDER**

- .1      Welded steel, pressure rating 1200 kPa (175 psi). Temperature rating: 90°C (194°F).

**2.3 CHEMICAL FEED PIPING**

- .1 Resistant to chemicals employed. Pressure rating: 1200 kPa (175 psi).

**2.4 CHEMICAL FEED PUMPS**

- .1 Top-mounted electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.
- .2 Piston type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with stainless steel piston, pressure relief valve, double ball and check valves.

**2.5 SHIPPING/ FEEDING CHEMICAL CONTAINERS**

- .1 High density moulded polyethylene, with liquid level graduations, cover.
- .2 Agitators: as required by manufacturer.

**2.6 CONDUCTIVITY CONTROLLER**

- .1 Fully transistorized, suitable for wall or flush panel mounting, linear over full measuring range of 0-5000 micro omhs.
- .2 Insensitive to phase angle shifts, capable of operating on 95-130 Volts without affecting accuracy, power, bleedoff status lights.

**2.7 CONDUCTIVITY PROBES**

- .1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.

**2.8 WATER TREATMENT FOR HYDRONIC SYSTEMS**

- .1 Hot water heating system: Pot feeder, 25 l (6.6 gal) or 19 l (5 gal).
- .2 Ten (10) Micron filter for each pot feeder:
  - .1 Capacity 2% of pump recirculating rate at operating pressure.
  - .2 Six (6) sets of filter cartridges for each type, size of micron filter.
- .3 Balancing valve set for 2% pump capacity.

**2.9 CHEMICALS**

- .1 Provide one (1) year's supply.

**2.10 TEST EQUIPMENT**

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, all specialized or supplementary equipment.

**2.11 CLEANING CHEMICALS**

- .1 Provide as required to make system clean.
- .2 Cleaner chemical: compatible and of the same manufacturer of the water treatment supplier.

**2.12 RECORD MANAGEMENT**

- .1 Provide cards and card holder mounted on wall adjacent to each pot feeder.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

**3.2 CHEMICAL FEED PIPING**

- .1 Install crosses at all changes in direction. Install plugs in all unused connections.

**3.3 WATER TREATMENT SERVICES**

- .1 After entire new and existing system is cleaned as specified elsewhere, provide monthly water treatment monitoring and consulting services for period of one year after system start-up. Provide written report to consultant after each visit. Service to include:
  - .1 Initial water analysis and treatment recommendations.
  - .2 System start-up assistance.
  - .3 On site system testing and recording of treated hydronic system.
  - .4 Operating staff training.
  - .5 Visit plant every 7 days during first month of operation and as required until system stabilizes and advise consultant in writing on treatment system performance.
  - .6 Provide monthly visits with reports after system has stabilized to the satisfaction of the owner.
  - .7 Provide necessary monthly recording charts and log sheets for one year operation.
  - .8 Provide necessary laboratory and technical assistance.
  - .9 Instructions and advice to operating staff to be clear, concise and in writing.

**3.4 WATER SOFTENER**

- .1 Install in accordance with manufacturer's instructions.
- .2 Install water meter in water softener inlet piping.

### **3.5 START-UP**

- .1 Start up water treatment systems in accordance with manufacturer's instructions.

### **3.6 SYSTEM COMMISSIONING AND TRAINING**

- .1 Commissioning and training shall be provided by installing water treatment sub-contractor and water treatment supplier.
- .2 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After start-up and before TAB of connected systems.
- .3 Pre-commissioning Inspections:
  - .1 Verify:
    - .1 Presence of test equipment, reagents, chemicals, details of specific tests to be performed, operating instructions.
    - .2 Suitability of log book.
    - .3 Currency and accuracy of initial water analysis.
    - .4 Required quality of treated water.
- .4 Commissioning procedures - applicable to all Water Treatment Systems:
  - .1 Establish, adjust as necessary and record all automatic controls and chemical feed rates.
  - .2 Monitor performance continuously during commissioning of all connected systems and until acceptance of project.
  - .3 Establish test intervals, regeneration intervals.
  - .4 Record on approved report forms all commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
  - .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
  - .6 Visit project at monthly intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
  - .7 Advise Engineer in writing on all matters regarding installed water treatment systems.
- .5 Commissioning procedures - Closed Circuit Hydronic Systems:
  - .1 Analyse water in system.
  - .2 Based upon an assumed rate of loss approved by Engineer, establish rate of chemical feed.
  - .3 Record types, quantities of chemicals applied.
  - .4 Provide written verification of glycol solution concentration.



- .6 Training:
  - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
  - .2 Train O&M personnel in softener regeneration procedures.
- .7 Certificates:
  - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .8 Commissioning Reports:
  - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, all other data required by Consultant.
- .9 Commissioning activities during Warranty Period:
  - .1 Check out water treatment systems on regular basis and submit written report to Consultant.

### **3.7 CLEANING OF MECHANICAL SYSTEM**

- .1 Coordinate cleaning of mechanical systems with mechanical contractor.
- .2 Provide copy of recommended cleaning procedures and chemicals for approval by Consultant.
- .3 Procedure:
  - .1 Flushing and cleaning should only take place after successful piping pressure testing.
  - .2 Terminal device (reheat coils, heat pumps, perimeter radiation, heat exchangers etc.), air handling unit coils and their associated control and balancing valves should be bypassed during the preliminary flushing and cleaning process.
  - .3 Instruments such as flow meters; flow metering valves and orifice plates should only be installed after flushing and cleaning.
- .4 Timing:
  - .1 The overall construction schedule identifies piping flushing and cleaning with realistic time allotments.
  - .2 The mechanical contractor is required to provide a detailed report outlining the processes and procedures for flushing and cleaning per piping system at least 4 to 6 weeks in advance of work.
  - .3 As a minimum, at least one piping flushing and cleaning procedure shall be witnessed, by the consultant and/or commissioning agent.
- .5 The mechanical contractor shall to utilize a qualified water treatment specialist to supervise the flushing and cleaning process and provide the certified water analysis report certifying that the piping systems are clean.
- .6 Coordinate flushing and cleaning of mechanical systems with HVAC water treatment contractor.
- .7 Flush and clean new piping system in presence of Owner

- .8 Flush after pressure test for a minimum of 4 hrs.
- .9 Fill system with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hrs.
- .10 Thoroughly flush all new mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.
- .11 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
- .12 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.
- .13 Drainage to include drain valves, dirt pockets, strainers, every low point in system.
- .14 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .15 Reinstall strainer screens/baskets only after obtaining Owner's approval and approval from HVAC water treatment contractor and board chemical treatment technician.
- .16 Repeat system drain and flush as often as necessary to have a clean system.
- .17 Disposal of cleaning solutions to be approved by authority having jurisdiction.
- .18 Isolate new piping system from existing system as required for system cleaning.

### **3.8 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:

Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 SMACNA HVAC Duct Leakage Test Manual.
- .4 ASTM A480/A480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .5 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process. (Metric).
- .6 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .7 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section general requirements.
- .2 Indicate following:
  - .1 Sealants
  - .2 Tape
  - .3 Proprietary Joints
  - .4 Fittings

**1.3 CERTIFICATION OF RATINGS**

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

**Part 2 Products**

**2.1 DUCTWORK**

- .1 Galvanized Steel:
  - .1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.

.2 Thickness:

Size Type	Class A Gauge	Class B Gauge	Class C Gauge
<b>Square and Rectangular</b>			
Up to 600 mm (24")	22	24	24
625 mm to 1000 mm (25" to 40")	20	22	24
1025 mm to 1800 mm (41" to 72")	18	20	22
1825 mm to 2400 mm (73" to 96")	16	18	20
2450 mm and over (97")	16	16	16
<b>Round and Oval</b>			
Up to 300 mm (12")	24	24	24
325 mm to 600 mm (13" to 24")	22	24	24
625 mm to 900 mm (25" to 36")	20	22	24
925 mm to 1200 mm (37" to 48")	18	20	22
1225 mm (49") and over	18	18	20

\*Following SMACNA for low pressure ductwork.

.3 All ductwork between HVAC unit connections and 3.0 m (10'-0") downstream or to silencers shall be 1.4 mm (18 gauge).

.2 Aluminum

- .1 To ASHRAE and SMACNA. Aluminum type: 3003-H-14.
- .2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA or as indicated.
- .3 Joints: to ASHRAE and SMACNA.
  - .1 Acceptable material:
    - .1 Ductmate Canada Ltd.
- .4 Foil tape all transverse and longitudinal joints.

## 2.2 DUCT CONSTRUCTION

- .1 Round and oval:
  - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
  - .2 Transverse joints up to 900 mm (36"): slip type with tape and sealants.
  - .3 Transverse joints over 900 mm (36"): Ductmate or Exanno Nexus Duct System.
- .2 Square and rectangular:
  - .1 Ducts: to SMACNA.
  - .2 Transverse joints, longest side:
    - up to and including 750 mm (30"): SMACNA proprietary duct joints.

- .3 Ducts with sides over 750 mm (30") to 1200 mm (48"), transverse duct joint system by Ductmate/25, Nexus, or WDCI (Lite) (SMACNA "E" or "G" Type connection). Weld all corners.
  - .1 Acceptable materials:
    - .1 Ductmate Canada Ltd.
    - .2 Nexus, Exanno Corp.
    - .3 WDCI
- .4 Ducts 1200 mm (48") and larger, Ductmate/35, Nexus, or WDCI (heavy) (SMACNA "J" Type connection). Weld all corners.
  - .1 Acceptable materials:
    - .1 Ductmate Canada Ltd.
    - .2 Nexus, Exanno Corp.
    - .3 WDCI.

## 2.3 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: standard radius and or short radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.
  - .2 Round:
    - .1 In exposed areas one-piece smooth radius, 1.5 times diameter.
    - .2 In concealed areas 3-piece adjustable, 1.5 times diameter.
- .3 Mitred elbows, rectangular:
  - .1 To 400 mm (16"): with double thickness turning vanes.
  - .2 Over 400 mm (16"): with double thickness turning vanes.
- .4 Branches:
  - .1 Rectangular main and branch: with 45° entry on branch.
  - .2 Round main and branch: enter main duct at 45° with conical connection.
  - .3 Provide volume control damper in branch duct near connection to main duct.
  - .4 Main duct branches: with splitter damper.
- .5 Diffuser connection to main:
  - .1 90° round spin in collars with balancing damper and locking quadrant.
- .6 Transitions:
  - .1 Diverging: 20° maximum included angle.
  - .2 Converging: 30° maximum included angle.
- .7 Offsets:
  - .1 Full short radiused elbows.
- .8 Obstruction deflectors: maintain full cross-sectional area.

## 2.4 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa (" w.c.)	SMACNA Seal Class	Acceptable Leakage Classification (Rectangular)	Acceptable Leakage Classification (Round)
2500 (10")	A	4	2
1500 (6")	A	4	2
1000 (4")	A	4	2
750 (3")	A	8	4
500 (2")	B	16	8
250 (1")	B	16	8
125 (0.5")	C	16	8

- .2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.
- .3 Class C: transverse joints and connections made air tight with gaskets, or sealant or combination thereof. Longitudinal seams sealed with foil tape or sealant.

## 2.5 SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of -30°C (-22°F) to plus 93°C (199°F).
- .2 Flame-spread rating not more than 25.
- .3 Smoke developed classification not more than 50.
- .4 Acceptable materials:
- .1 Duro Dyne S-2
- .2 Foster

## 2.6 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm (2") wide.
- .1 Acceptable material:
- .1 Duro Dyne FT-2

## 2.7 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

## 2.8 FIRESTOPPING

- .1 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angles all around duct, on both sides of fire separation.

- .2 Firestopping material and installation must not distort duct.
- .3 All ductwork passing through partition walls shall be firestopped.

## 2.9 KITCHEN EXHAUST SYSTEMS

- .1 Hood shall be constructed of 18 gauge minimum, 300 Series stainless steel outer shell.
- .2 Material: Type 316 stainless steel sheet or carbon steel.
- .3 Fabrication: as indicated.

## 2.10 WATERTIGHT DUCT

- .1 Provide watertight duct for:
  - .1 Fresh air intake.
  - .2 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer.

## 2.11 HANGERS AND SUPPORTS

- .1 Band hangers: use on round and oval ducts only up to 500 mm (20") diameter, of same material as duct but next sheet metal thickness heavier than duct.
- .2 Trapeze hangers: ducts over 500 mm (20") diameter or longest side, to ASHRAE and SMACNA.
- .3 Hangers: galvanized steel angle with black steel rods to ASHRAE and SMACNA following table:

Duct Size mm (")	Angle Size mm (")	Rod Size mm (")
up to 750 (30)	25 x 25 x 3 (1 x 1 x 1/8)	6 (1/4)
>750 to 1050 (>30 to 42)	40 x 40 x 3 (1½ x 1½ x 1/8)	6 (1/4)
>1050 to 1500 (>42 to 60)	40 x 40 x 3 (1½ x 1½ x 1/8)	10 (3/8)
>1500 to 2100 (>60 x 84)	50 x 50 x 3 (2 x 2 x 1/8)	10 (3/8)
>2100 to 2400 (>84 x 96)	50 x 50 x 5 (2 x 2 x 1/8)	10 (3/8)
>2400 (96) and over	50 x 50 x 6 (2 x 2 x ¼)	10 (3/8)

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.
    - .1 Acceptable material:
      - .1 Myatt fig. 485
  - .2 For steel joist: manufactured joist clamp or steel plate washer.
    - .1 Acceptable material:
      - .1 Grinnell fig. 61 or 60
  - .3 For steel beams: manufactured beam clamps:
    - .1 Acceptable material:
      - .1 Grinnell Fig. 60

**Part 3 Execution**

**3.1 GENERAL**

- .1 The following systems shall conform to these requirements:

System	Class	Material
HVAC Supply and Return	B	Galvanized steel
General Exhaust	B	Galvanized steel
Shower Exhaust	B	Aluminum
Ventilation Plenum	B	Galvanized steel
Exhaust Plenum	B	Galvanized steel
Individual Exhaust	C	Galvanized steel
Kitchen Exhaust	B	Galvanized steel

- .2 Do work in accordance with ASHRAE and SMACNA.  
 .3 Do not break continuity of insulation vapour barrier with hangers or rods.  
 .4 Support risers in accordance with ASHRAE and SMACNA.  
 .5 Install breakaway joints in ductwork on each side of fire separation.  
 .6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.  
 .7 Manufacture duct in lengths to accommodate installation of acoustic duct lining.

**3.2 HANGERS**

- .1 Strap hangers: install in accordance with SMACNA.  
 .2 Angle hangers: complete with locking nuts and washers.  
 .3 Hanger spacing: in accordance with ASHRAE, SMACNA and as follows:

Duct Size	Spacing
mm (")	mm (")
to 1500 (60")	3000 (120")
over 1500 (60")	2500 (100")

- .4 Do not support ductwork over 250 mm x 250 mm (10" x 10") from roof deck.

**3.3 WATERTIGHT DUCT**

- .1 Slope horizontal branch ductwork down towards hoods served. Slope header ducts down toward risers.  
 .2 Fit base of riser with 150 mm (6") deep drain sump and 25 mm (1") drain connected, with deep seal trap and valve and discharging to open funnel drain.



### **3.4 KITCHEN EXHAUST SYSTEMS**

- .1 Install to ANSI/NFPA 96 and as indicated.
- .2 Provide smoke test on exhaust ductwork and report to the engineer.
- .3 Provide smoke test on system to the local authorities' requirements.

### **3.5 SEALING**

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

### **3.6 LEAKAGE TESTS**

- .1 Co-ordinate leakage testing with TAB contractor. TAB contractor will be responsible for all duct testing.
- .2 Duct to be tested in accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Leakage tests to be done in sections.
- .4 Trial leakage tests to be performed as instructed to demonstrate workmanship.
- .5 Install no additional ductwork until trial test has been passed.
- .6 Test section to be minimum of 15 m (50'-0") long with not less than 3 branch takeoffs and two 90° elbows. Maximum test length and area to be determined by BAS testing equipment. Allow for twelve (12) tests.
- .7 Complete test before insulation or concealment.
- .8 Provide all necessary end caps and fittings as required for the TAB contractor. Remove same after successful completion of duct test.
- .9 Pressure test ductwork to 1½ times operating pressure (minimum pressure 500 Pa (2" wc) all systems).

### **3.7 CLEANING**

- .1 Keep ducts clear from dust and debris
- .2 Keep duct liner clean from dust, debris, and moisture.
- .3 At completion of project vacuum ducts if dirt or dust is present.
- .4 Ensure all systems are clean prior to start up.

### **3.8 INSTALLATION REQUIREMENTS**

- .1 All ductwork is to be protected from the weather and precipitation. The top and sides of all ductwork are to be completely covered with 6mil poly to the satisfaction of the consultant. Maintain protection of the ductwork until the building is made watertight and hollow cores drained. Tape all joints.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 ANSI/NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 CSA B228.1, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
  - .1 Flexible connections.
  - .2 Duct access doors.
  - .3 Turning vanes.
  - .4 Instrument test ports.

**1.3 CERTIFICATION OF RATINGS**

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

**Part 2 Products**

**2.1 GENERAL**

- .1 Manufacture in accordance with CSA B228.1.

**2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at -40°C (-40°F) to plus 90°C (194°F), density of 1.3 kg/m.

**2.3 ACCESS DOORS IN DUCTS**

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (25 gauge) thick complete with sheet metal angle frame.

- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (24 gauge) thick complete with sheet metal angle frame and 25 mm (1") thick rigid glass fibre insulation.
- .3 Gaskets: neoprene
- .4 Hardware:
  - .1 Up to 300 mm (12"): 2 sash locks
  - .2 301 mm to 450 mm (13" to 18"): 4 sash locks Complete with safety chain.
  - .3 451 mm to 1000 mm (19" to 40"): piano hinge and minimum 2 sash locks.
  - .4 Doors over 1000 mm (40"): piano hinge and 2 handles operable from both sides.
  - .5 Hold open devices.
- .5 Acceptable materials:
  - .1 Nailor
  - .2 E. H. Price
  - .3 Titus
- .6 Provide access doors in kitchen exhaust duct with bolted cover to the requirements of NFPA and authority having jurisdiction.

## **2.4 TURNING VANES**

- .1 Factory or shop fabricated double thickness, to recommendations of SMACNA and as indicated.
- .2 Acceptable materials:
  - .1 Duro Dyne
  - .2 Ductmate

## **2.5 INSTRUMENT TEST PORTS**

- .1 1.6 mm (16 gauge) thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm (1 1/8") minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.
- .5 Acceptable material:
  - .1 Duro Dyne IP1 or IP2
  - .2 Duct mate

## **2.6 PREFABRICATED ROOF CURB**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: 1.3 mm (18 gauge) galvanized steel with raised cant and wood nailer.
- .3 25 mm (1") insulation 3 lb density.

- .4 Acceptable materials:
  - .1 Greenheck GPR – 600 mm (24") high
  - .2 Penn

## **2.7 SPIN-IN COLLAR**

- .1 Construction: galvanized straight or conical spin-in collar complete with spin-in bead and crimped collar connection.
- .2 Provide balancing damper where indicated.
- .3 Acceptable materials:
  - .1 Ecco Manufacturing
  - .2 Flex Master

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Flexible connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans. (Unless internally isolated)
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm (4").
  - .3 Minimum distance between metal parts when system in operation: 75 mm (3").
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on each side of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access doors and viewing panels:
  - .1 Size:
    - .1 600 mm x 600 mm (24" x 24") for person size entry.
    - .2 600 mm x 1000 mm (24" x 40") for servicing entry.
    - .3 300 mm x 300 mm (12" x 12") for viewing.
    - .4 As indicated.
  - .2 Location:
    - .1 At fire and smoke dampers.
    - .2 At control dampers.
    - .3 At devices requiring maintenance.
    - .4 At locations required by code.
    - .5 At inlet and outlet of reheat coils.

- .6 Elsewhere as indicated.
    - .7 Inlet and outlet of duct mounted coils.
  - .3 Instrument test ports.
    - .1 General:
      - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
      - .2 Locate to permit easy manipulation of instruments
      - .3 Install insulation port extensions as required.
      - .4 Locations.
        - .1 For traverse readings:
          - .1 At ducted inlets to roof and wall exhausters.
          - .2 At inlets and outlets of other fan systems.
          - .3 At main and sub-main ducts.
          - .4 And as indicated.
        - .2 For temperature readings:
          - .1 At outside air intakes.
          - .2 In mixed air applications in locations as approved by Consultant.
          - .3 At inlet and outlet of coils.
          - .4 Downstream of junctions of two converging air streams of different temperatures.
          - .5 And as indicated.
  - .4 Turning vanes:
    - .1 Install in accordance with recommendations of SMACNA and as indicated.
    - .2 Install on supply ducts only.

### **3.2 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements
- .2 Indicate the following: performance data.

**Part 2 Products**

**2.1 GENERAL**

- .1 Manufacture to SMACNA standards.

**2.2 SINGLE BLADE DAMPERS**

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened, minimum 1.6 mm (16 gauge).
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm (4").
- .3 Shaft extension to accommodate insulation thickness and locking quadrant.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

**2.3 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height:
  - .1 50 mm (2") up to 375 mm (15") high duct.
  - .2 100 mm (4") max 400 mm (16") high duct and over.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 **Shaft extension to accommodate insulation thickness and locking quadrants.**

- .8 Acceptable materials:
  - .1 Duro Dyne
  - .2 E.H. Price
  - .3 Nailor
  - .4 T.A. Morrison
  - .5 Tamco
  - .6 Ruskin
  - .7 Ventex/Alumavent
  - .8 United Enertech

## 2.4 LOCKING QUADRANTS

- .1 6 mm (1/4") dial regulator with square bearing shaft.
  - .1 18 gauge oval frame, cadmium plated, clearly shows damper position.
  - .2 18 gauge formed handle for easy adjustment.
  - .3 Bolt and wing nut lock damper securely.
  - .4 Offset mounting holes avoid interference with damper movement and mechanical fastening to duct.
- .2 9 mm (3/8") and larger: clamp quadrant with square bearing shaft.
  - .1 Accommodates and securely locks square rod, bearing fitting and adaptor pins.
  - .2 Heavily ribbed 16 gauge steel frame, 3 mm (1/8") thick formed steel handle, cadmium-plated.
  - .3 By tightening nut, bearing is securely locked in handle, preventing slippage and rattle.
  - .4 Neoprene and steel washer assembly seals bearing opening to eliminate air-leakage.
  - .5 Screw holes for mechanically fastening to ductwork.
- .3 High pressure system locking quadrant:
  - .1 Airtight, rattle-proof regulator, designed for ZERO leakage at high pressure. Use for applications up to 500°F constant temperature.
  - .2 Handle design for easy recognition of damper position.
  - .3 Heavy-gauge, zinc-plated steel, 2 high temperature rubber seals and washers, end bearing support, and 2 end bearings. Pressure loss and damper rattle in ductwork has been a constant annoyance for as long as HVAC ductwork has been installed. Now, a truly air-tight, rattle-proof regulator is available. The SPEC-SEAL regulator utilizes a special high-temperature rubber seal to eliminate leakage and rattle even at many times the pressure found in high pressure.
  - .4 Soft, comfortable grip handle with a highly-visible, plastic cover which indicates the damper position.
  - .5 Handle to accommodate 9 mm (3/8") or 12 mm (1/2") to match damper shaft size, square and round bearing shafts.

- .4 Acceptable manufacturers:
  - .1 Duro Dyne
  - .2 Ductmate
  - .3 Pottorff

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
  - .1 Single blade dampers up to 200 mm (8").
  - .2 Multi-blade dampers over 200 mm (8").
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 All dampers to be vibration free.
- .6 Leave all dampers in open position for T.A.B.
- .7 Fasten locking quadrants to ductwork and shaft.
- .8 Place locking quadrants on standoffs where ductwork insulated.
- .9 Lock down quadrant arm in the open position.

#### **3.2 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .3 CAN/ULC-S112, Standard Method of Fire Test of Fire Damper Assemblies.
- .4 CAN/ULC-S112.1, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .5 ULC-S505, Fusible Links for Fire Protection Service.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
  - .1 Fire dampers.
  - .2 Operators.
  - .3 Firestop flaps.
  - .4 Fusible links.

**1.3 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

**1.4 MAINTENANCE MATERIALS**

- .1 Provide following:
  - .1 Six (6) fusible links of each type.

**1.5 CERTIFICATION OF RATINGS**

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

**Part 2 Products**

**2.1 FIRE DAMPERS (DYNAMIC)**

- .1 Multi blade or roll type, fire damper suitable for HVAC system velocities up to 2000 fpm (610 m/mm), dual direction air flow, max 4" wg pressure.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; guillotine type; sized to maintain full duct cross section.

- .4 Stainless closure spring to positively close damper upon fusible link release, for horizontal or vertical orientations.
- .5 Linkage concealed in frame.
- .6 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .7 Fire damper assemblies and type to meet requirements of provincial fire authority and authority having jurisdiction.
- .8 Acceptable materials:
  - .1 Ruskin
  - .2 Nailor
  - .3 E.H. Price
  - .4 T.A. Morrison
  - .5 Tamco
  - .6 Greenheck
  - .7 Ventex/Alumavent
  - .8 Pottorff

## **2.2 MULTIBLADE DAMPERS (DYNAMIC)**

- .1 Provide and install multiblade dampers where roll type fire dampers do not have a ULC listing for the size of the penetration through the assembly.
- .2 Multi blade type fire dampers shall be suitable for HVAC system velocities up to 2000 fpm (610 m/min), dual direction air flow, max 4" wg pressure.
- .3 Damper shall be labelled for dynamic or static systems as appropriate for the installed location.
- .4 Frame shall be constructed on 16 ga (1.6) steel hat channel with mitered corners reinforced with die-formed corner gussets for strength.
- .5 Damper blades shall be 14 ga (2.0) equivalent steel formed double skin, airfoil design.
- .6 Damper shall be of opposed blade configuration with an interlocking blade design. Blade seals are not acceptable.
- .7 Blade axels shall be double bolted at each end of the blade to provide positive locking connection.
- .8 Bearings shall be sintered stainless steel type.
- .9 Blade linkage shall be zero-maintenance, concealed in frame and out of the air stream.
- .10 Each damper shall be complete with a UL listed fusible link that will cause the damper to close and lock in closed position by means of an over centre/knee lock linkage for assured closure.
- .11 Each damper shall be provided with an internal manual locking quadrant(s) for setting and locking of blades in desired position.

- .12 Provide a steel sleeve of appropriate gauge and length for the assembly being penetrated.
- .13 Provide a 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .14 Fire damper assemblies and type to meet requirements of provincial fire authority and authority having jurisdiction.
- .15 Acceptable materials:
  - .1 Ruskin
  - .2 Nailor
  - .3 E.H. Price
  - .4 T.A. Morrison
  - .5 Tamco
  - .6 Greenheck
  - .7 Ventex/Alumavent
  - .8 Pottorff

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Provide where indicated and at all fire rated partitions indicated, on architectural drawing.
- .2 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .3 Maintain integrity of fire separation.
- .4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .5 Install access door adjacent to each damper.
- .6 Coordinate with installer of firestopping.
- .7 Dynamic fire dampers: In all duct work where air is moved by a fan/blower.

#### **3.2 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL**

- .1 This section applies to operating dampers not specified in Controls Section.

**1.2 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

**1.3 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
  - .1 Performance data.

**1.4 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

**1.5 CERTIFICATION OF RATINGS**

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

**Part 2 Products**

**2.1 MOTORIZED DAMPERS**

- .1 Opposed blade type.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Operator: Refer to BAS Section.
- .6 Performance:
  - .1 Leakage: in closed position to be less than 2% of rated air flow at 250 Pa (1" w.c.) differential across damper.
  - .2 Pressure drop: at full open position to be less than 10 Pa (0.04" w.c.) differential across damper.

- .7 Insulated aluminum dampers:
  - .1 Frames: insulated with extruded polystyrene foam with R factor of 5.0.
  - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 5.0.
  - .3 Use on services to the exterior.
  - .4 Acceptable materials:
    - .1 Honeywell
    - .2 Johnson
    - .3 T. A. Morrison
    - .4 E.H. Price
    - .5 Tamco
    - .6 Ruskin
    - .7 Nailor
    - .8 Henderson Industrial
    - .9 Ventex/Alumavent
    - .10 Pottorff

## 2.2 DISC TYPE DAMPERS

- .1 Frame: brake formed, welded, 1.6 mm (16 gauge) thick, Type Z90 galvanized steel to ASTM A653/A653M.
- .2 Disc: spin formed, 1.6 mm (16 gauge) thick, Type Z90 galvanized steel to ASTM A653/A653M.
- .3 Gasket: extruded neoprene, field replaceable.
- .4 Bearings: roller self lubricated and sealed.
- .5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.
- .6 Performance:
  - .1 Leakage: in closed position to be less than 0.001% of rated air flow at 100 kPa (15 psi) pressure differential across damper.
  - .2 Pressure drop: at full open position to be less than 100 kPa (15 psi) differential across damper.
- .7 Acceptable material:
  - .1 Duro Dyne
  - .2 Henderson Industrial
  - .3 Pottorff

## **2.3 BACK DRAFT DAMPERS**

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted or counterweighted, as indicated.
- .2 Acceptable materials:
  - .1 T.A. Morrison
  - .2 Tamco Series 7000
  - .3 Ruskin
  - .4 Nailor
  - .5 E.H. Price
  - .6 Henderson Industrial
  - .7 Ventex/Alumavent
  - .8 Pottorff

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Duct Accessories Section.
- .5 Insulated dampers on all outside air intake and exhaust damper.
- .6 Non-insulated dampers on all interior motorized dampers not exposed to outside air.

### **3.2 ELECTRICAL ROOM DAMPER OPERATION**

- .1 Outdoor air damper modulates open on increase of room temperature above 80°F.
- .2 When damper is fully open end switch start exhaust fan.
- .3 When temperature reaches below setpoint damper is closed and exhaust fan off.

### **3.3 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
  - .2 Disk type dampers gasket: Ten (10) years warranty.

.3      Warranty Coverage:

Applies to parts and labour.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CAN/ULC-S110, Standard Methods of Test for Air Ducts.
- .3 UL 181, Factory Made Air Ducts and Air Connectors.
- .4 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .5 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .6 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
  - .1 Thermal properties.
  - .2 Friction loss.
  - .3 Acoustical loss.
  - .4 Leakage.
  - .5 Fire rating.

**1.3 CERTIFICATION OF RATINGS**

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

**Part 2 Products**

**2.1 GENERAL**

- .1 Factory fabricated to CAN/ULC S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

**2.2 METALLIC – UNINSULATED**

- .1 Spiral wound flexible aluminum, Class 1 duct material.

- .2 Performance:
  - .1 Factory tested to 2.5 kPa (10" w.c.) without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Operating pressure: 300 mm (12").
- .3 Acceptable materials:
  - .1 Flexmaster T/L
  - .2 Ductmate

### **2.3 METALLIC –INSULATED**

- .1 Spiral wound flexible aluminum with factory applied, 25 mm (1") thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket, Class 1 duct material.
- .2 Performance:
  - .1 Factory tested to 2.5 kPa (10" w.c.) without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Operating pressure: 300 mm (12").
- .3 Acceptable materials:
  - .1 Flexmaster T/L – VT
  - .2 Ductmate

## **Part 3 Execution**

### **3.1 DUCT INSTALLATION**

- .1 Install in accordance with: SMACNA.
- .2 Maximum length of flexible duct: 1.8 m (6' 0").
- .3 Minimum length of acoustical ductwork; 1.5 m (5' 0") with minimum of 1 bend.
- .4 Provide support at centre of flexible duct with 25 mm (1") wide galvanized hanger.
- .5 Insulated flexible ductwork in areas where ceilings are not utilized as return air plenums.
- .6 Uninsulated flexible ductwork in areas where ceilings are utilized as return air plenums.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 ASTM C1071 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- .4 ASTM C916 Standard Specification for Adhesive for Duct Thermal Insulation.
- .5 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .6 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .7 **ASTM C177, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.**
- .8 **CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.**

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.

**Part 2 Products**

**2.1 RECTANGULAR/SQUARE DUCT LINER**

- .1 General:
  - .1 Acoustical duct liner to be fibreglass duct liner meeting or exceeding requirements of ASTM C1071, Type I, Flexible or Type II, Rigid, and NFPA 90A/90B.
  - .2 Bonded with formaldehyde free bio-based binder
  - .3 Mat faced airstream surface
  - .4 Factory applied edge coating
  - .5 Shall not contain formaldehyde, PBDE's, asbestos, mercury, mercury compounds, lead, contain 50% or greater recycled glass content.
  - .6 Thermal conductivity, ASTM C177/C518/C1114 .24BTU (sf•hr•°F) @ 75°F mean temp).
  - .7 Noise Reduction Coefficient (NRC) 1.5 PCF 1" = .70, 1 ½ " = .80, 2" =.95  
ASTM C423, Type A mounting.
  - .8 Noise Reduction Coefficient (NRC) 2.0 PCF 1/2" = .50, 1" = .70, 1 ½ " = .85  
ASTM C423, Type A mounting
  - .9 Corrosiveness/corrosion, ASTM C665/C1617. Does not accelerate/pass.
  - .10 Mold and mildew growth/fungi resistance, ASTM C1338, ASTM G21/G22, UL2824. Pass/resistant to mold.

- .11 Maximum service temperature, ASTM C411, 250°F (121°C).
- .12 Maximum rate air velocity, ASTM C1071, 6,000 ft./min. (30.5 m/sec.)
- .13 Water vapor sorption, ASTM C1104, less than 3%.
- .14 Surface burning characteristics, ASTM E84, UL 273, CAN/ULC S102, 20/50 flame spread/smoke development.
- .15 Acceptable material:
  - .1 Knauf Atmosphere Duct Liner
  - .2 Manson
  - .3 Johns Manville
  - .4 Owen Corning
- .2 Rigid:
  - .1 Use on flat surfaces.
  - .2 25 mm (1") thick, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.
  - .3 Density: 96 kg/m<sup>3</sup> (6 lb/ft<sup>3</sup>).

## **2.2 FLEXIBLE/ROUND ACOUSTIC DUCT LINER**

- .1 General:
  - .1 Acoustical duct liner to be fibreglass duct liner meeting or exceeding requirements of ASTM C1071, Type I, Flexible, and NFPA 90A/90B.
  - .2 Liner to have factor made, evenly spaced kerfs to allow material to conform to interior of round duct.
  - .3 Bonded with formaldehyde free bio-based binder
  - .4 Airstream Surface protected by acrylic coating.
  - .5 Factory applied edge coating
  - .6 Shall not contain formaldehyde, PBDE's, asbestos, mercury, mercury compounds, lead, contain 50% or greater recycled glass content.
  - .7 Thermal conductivity, ASTM C177/C518/C1114 0.23 BTU (sf•hr•°F) @ 75°F mean temp).
  - .8 Noise Reduction Coefficient (NRC) 1" = 0.75, 1 ½ " = 0.85, 2" = 0.95  
ASTM C423, Type A mounting.
  - .9 Mold and mildew growth/fungi resistance, ASTM C1338, ASTM G21/G22, UL2824. Pass/resistant to mold.
  - .10 Maximum service temperature, ASTM C411, 250°F (121°C).
  - .11 Maximum rate air velocity, ASTM C1071, 6,000 ft./min. (30.5 m/sec.)
  - .12 Water vapor sorption, ASTM C1104, less than 3%.
  - .13 Surface burning characteristics, ASTM E84, UL 273, CAN/ULC S102, 20/50 flame spread/smoke development.

- .14 Acceptable material:
  - .1 Johns Manville Spiracoustic
  - .2 Knauf
  - .3 Manson
  - .4 Owen Corning

- .2 Flexible:
  - .1 Use on round or oval surfaces only.
  - .2 25 mm (1") thick, to ASTM C1071, fibrous glass blanket duct liner.
  - .3 Density: 64 kg/m<sup>3</sup> (4.0 lb/ft<sup>3</sup>).

### **2.3 ADHESIVE**

- .1 Meet requirements of ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -29°C (-20°F) to 93°C (200°F).
- .3 Acceptable material:
  - .1 Duro Dyne 1A-22
  - .2 Ductmate

### **2.4 FASTENERS**

- .1 Weld pins 2.0 mm (14 gauge) diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm (1¼") square.
- .2 Acceptable material:
  - .1 Duro Dyne
  - .2 Ductmate

### **2.5 JOINT TAPE**

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm (2") wide.
- .2 Acceptable materials:
  - .1 Duro Dyne FT2
  - .2 Ductmate

### **2.6 SEALER**

- .1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -68°C (-90°F) to 93°C (200°F).
- .3 Acceptable materials:
  - .1 Duro Dyne 1A-94
  - .2 Ductmate

**Part 3 Execution**

**3.1 GENERAL**

- .1 Do work in accordance with recommendations of MAIMA Fibrous Glass Duct Liner Standards (FGDLS) or SMACNA duct liner standards.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.
- .4 Provide an interior of ductwork from fans from minimum distance of 3 m (10'-0").

**3.2 DUCT LINER**

- .1 Install in accordance with manufacturer's recommendations, and as follows:
  - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
  - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 300 mm (12") on centres.
- .2 Weld pins are to have cupped or beveled heads to prevent damage to lining surface.
- .3 Store foam liners away from sunlight.

**3.3 JOINTS**

- .1 Seal all butt joints, exposed edges, weld pin and clip penetrations and all damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's recommendations, and as follows:
  - .1 Bed tape in sealer.
  - .2 Apply 2 coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Consultant.
- .3 Protect leading and trailing edges of each duct section with sheet metal nosing having 15 mm (1/2") overlap and fastened to duct.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 AMCA 99, Standards Handbook.
- .3 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Certified Aerodynamics Performance Rating.
- .4 AMCA 300, Revised 1987, Reverberant Room Method for Sound Testing of Fans.
- .5 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .6 ANSI/ASHRAE 51, Laboratory Methods of Testing Fans for Certified Aerodynamics Performance Rating.
- .7 ANSI/NFPA 96 – Ventilation Control and Fire Protection of Commercial Cooking Operations.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Product data to include fan curves and sound rating data.

**1.3 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into manual specified in general requirements.

**1.4 CERTIFICATION OF RATINGS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
- .2 Provide confirmation of testing.

**Part 2 Products**

**2.1 FANS GENERAL**

- .1 Capacity: flow rate, total static pressure Pa, r/min, W (" w.c., r/min, bhp) model and size and sound ratings as indicated on schedule.
- .2 Statically and dynamically balanced. Constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301, tested to AMCA 300.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51.

- .5 Bearings: sealed lifetime of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80,000 100,000 h in accordance with AFBMA L10 life standard. Bearings to be rated and selected in accordance with AFBMA 9 and AFBMA 11.
- .6 Provide vibration isolation hangers/pads for all fans.
- .7 Electrical components and motors within the airstream shall be classified for use in a Class I, Zone 2 system (as defined by the Electrical Safety Code) when connected to ductwork systems served by refrigerant containing air handling systems.
- .8 Acceptable materials:
  - .1 Greenheck
  - .2 Penn-Barry
  - .3 Cook
  - .4 Jenco (S & P)/Jenn
  - .5 Carnes
  - .6 Twin-City
  - .7 Fantech
- .9 Provide factory mounted speed control for all direct drive motors.

## **2.2 WALL EXHAUSTERS**

- .1 Centrifugal backward inclined or Axial fan units, V belt or direct driven as indicated.
  - .1 Spun aluminum housings, complete with resilient mounted motor and fan.
  - .2 15 mm (1/2") mesh 2.0 mm (79 mil) diameter aluminum birdscreen.
  - .3 Automatic gasketted aluminum backdraft dampers.
  - .4 Disconnect switch within fan housing.
  - .5 Cadmium plated securing bolts and screws.
- .2 Housings:
  - .1 Provide with rubber or neoprene grommets for wiring passages, integral attachment collar, or angle ring mounted to mating flanged wall sleeve with full gasketting.
  - .2 Discharge pattern: away from building.
- .3 Size, type, and capacity: as indicated.

## **2.3 UPBLAST STYLE WALL EXHAUSTERS**

- .1 Centrifugal V belt or direct driven as indicated.
  - .1 Housing: spun aluminum complete with resilient mounted motor and fan.
  - .2 Impeller: aluminum non-overloading.
  - .3 Adjustable motor sheave
  - .4 15 mm (1/2") mesh 2.0 mm (79 mil) diameter aluminum birdscreen.
  - .5 Automatic gasketted aluminum backdraft dampers.



- .6 Disconnect switch within fan housing.
- .7 Continuous curb gaskets, cadmium plated securing bolts and screw, and sound insulating.
- .2 Roof curbs: of same manufacturer as fan and built to suit model specified. Roof curbs to be minimum 500 mm (20") high except where indicated otherwise. Roof curbs for NFPA 96 fans are to be vented. Size, type, and capacity: as indicated
- .3 Power feed shall be thru roof curb.
- .4 To NFPA 96 requirements where indicated.

#### **2.4 CABINET FANS – IN-LINE**

- .1 Fan characteristics and construction: as centrifugal fans.
- .2 Casing floor mounted or cabinet hung single inlet aluminum wheel in factory fabricated casing complete with vibration isolators and seismic control measures, motor, V-belt drive and guard inside or outside casing as indicated.
- .3 Fabricate casing of zinc coated or phosphate treated steel reinforced and braced for rigidity. Provide removable panels for access to interior. Uncoated, steel parts shall be painted over with corrosion resistant paint to CAN/CGSB 1.181. Internally line cabinet with 25 mm (1") thick rigid acoustic insulation, pinned and cemented bell mouth inlet cone.
- .4 Size, type, and capacity: as indicated.

#### **2.5 CEILING DISCHARGE FANS**

- .1 Centrifugal direct drive, with plug in type electric motor suitable for ceiling installation, zinc coated rectangular metal housing.
- .2 Sizes and capacity: as indicated.
- .3 Toggle switch operated complete with integral electrical outlet box with plug-in type receptacle.
- .4 Side duct outlet with integral backdraft damper, size as indicated.
- .5 Wall cap complete with spring loaded backdraft damper with neoprene gasket.
- .6 Silver anodized aluminum grille paint finish.

#### **2.6 RANGE HOOD EXHAUST FANS**

- .1 Centrifugal wall-mount ducted NFPA-101 exhaust fan provided by kitchen range hood manufacturer (Denlar).
- .2 Sizes and capacity: as indicated.
- .3 Control by Denlar range hood integral controller.
- .4 Integral backdraft damper.
- .5 Provide flashing suitable for integration of fan into wall assembly.

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**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install in accordance with manufacturer's instructions.
- .2        Provide flexible duct connection for all fans.
- .3        Provide backdraft damper at building exterior penetration.
- .4        Provide and install vibration isolation.
- .5        Provide and install roof curb for all roof mounted fans.
- .6        Provide and install sleepers for utility set style roof mounted fans; provide roof curb for duct penetration.

**3.2                WARRANTY**

- .1        Warranty Start Date:
  - .1        Warranty period starts as of the date of Ready for Takeover.
  - .2        Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2        Warranty Duration:
  - .1        Two (2) year warranty period applies.
- .3        Warranty Coverage:
  - .1        Applies to parts and labour.

**END OF SECTION**

**Part 1            General**

**1.1            PRODUCT DATA**

- .1    Submit product data in accordance with general requirements.
- .2    Indicate the following:
  - .1    Capacity.
  - .2    Throw and terminal velocity.
  - .3    Noise criteria.
  - .4    Pressure drop.
  - .5    Neck velocity.

**1.2            MAINTENANCE MATERIALS**

- .1    Include:
  - .1    Keys for volume control adjustment.
  - .2    Keys for air flow pattern adjustment.

**1.3            MANUFACTURED ITEMS**

- .1    Grilles, registers, and diffusers of same generic type to be product of one manufacturer.

**1.4            CERTIFICATION OF RATINGS**

- .1    Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by them from independent testing agency signifying adherence to codes and standards.

**Part 2           Products**

**2.1           GENERAL**

- .1    To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2    Frames:
  - .1    Full perimeter gaskets.
  - .2    Plaster frames where set into plaster or gypsum board and as specified.
  - .3    Concealed fasteners.
- .3    Concealed operators.
- .4    Colour and Finish: standard as directed by Consultant.

- .5 Acceptable materials:
  - .1 E.H. Price
  - .2 Nailor
  - .3 Krueger
  - .4 Titus
  - .5 Carnes
  - .6 Seiho
  - .7 Metalaire
  - .8 Tuttle and Bailey

## **2.2 SUPPLY GRILLES AND REGISTERS**

- .1 Type, size, and capacity: as indicated.

## **2.3 RETURN AND EXHAUST GRILLES**

- .1 Type, size, and capacity: as indicated.

## **2.4 DIFFUSERS**

- .1 Type, size, and capacity: as indicated.

## **2.5 LINEAR BAR, WALL GRILLES**

- .1 Type, size, and capacity: as indicated.

## **2.6 OPEN MESH SCREEN**

- .1 15 mm x 15 mm (½"x ½") open mesh screen fastened on 25 mm (1") border, screw fasten.
- .2 On all open ends of ductwork and where indicated.
- .3 Size: To match ductwork size.

## **2.7 DOOR GRILLES**

- .1 Heavy duty steel construction, sight proof, complete with flat border both sides, screwed fastening. Finish by Consultant.
- .2 Install door grille in door.
- .3 Acceptable manufacturer:
  - .1 EH Price

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head screws in countersunk holes where fastenings are visible.

- .3 Bolt grilles, registers and diffusers, in place
- .4 Provide concealed safety chain on each grille, register and diffuser in high-bay areas, and elsewhere as indicated.
- .5 Clean grilles upon completion.
- .6 Paint ductwork beyond grilles, matte black where visible.
- .7 Ensure all grilles, diffusers, etc. match opening sizes as indicated on the drawings and as fabricated on site by the contractor.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM E90, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions, and Elements.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
  - .1 Pressure drop.
  - .2 Face area.
  - .3 Free area.
  - .4 Colour and finish.

**1.3 CERTIFICATION OF RATINGS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

**1.4 TEST REPORTS**

- .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

**Part 2 Products**

**2.1 FIXED LOUVRES – ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm (60").
- .4 Frame, head, sill and jamb: 100 mm (4") deep one piece extruded aluminum, minimum 3 mm (1/8") thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm (60") maximum centres.
- .6 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 15 mm (1/2") exhaust 20 mm (3/4") intake mesh, 2 mm (5/64") diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

- .8 Finish:  
Powder Coated  
Colour: to Consultant's approval.
- .9 Acceptable materials:
  - .1 E. H. Price
  - .2 Construction Specialties
  - .3 Greenheck
  - .4 Krueger
  - .5 Ruskin
  - .6 Ventmaster
  - .7 Ventex
  - .8 Nailor

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 In accordance with manufacturers and SMACNA recommendations.
- .2 Reinforce and brace air vents, intakes and goosenecks as indicated.
- .3 Anchor securely into opening.
- .4 Seal with caulking all around to ensure weather tightness.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Pre-Engineered fire suppression hoods shall be Denlar D1000 Series.
- .2 Hood system shall be installed as ETL tested and UL300A compliant.
- .3 NFPA 101 compliance is an available option on the Denlar D1000.
- .4 The Hood shall be operating at a minimum of 500 CFM when NFPA101 compliant.
- .5 The Hood shall be installed with an integral fire extinguishing system that is mechanically activated by heat.
- .6 D1000 Hoods shall be installed over a like sized residential range or cooktop.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general requirements.

**1.3 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in general requirements

**1.4 CERTIFICATION OF RATINGS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

**Part 2 Products**

**2.1 STANDARDS OF CONSTRUCTION**

- .1 Hood shall be constructed of 18 gauge minimum, 300 Series stainless steel outer shell.
- .2 Hood shall be either 30 inches wide (to cover 30-inch range) or 36 inches wide (to cover 36-inch range).
- .3 Hood shall be manufactured and assembled with no visible outer welds or weld marks.
- .4 All internal seams shall be sealed with NSF-approved caulk, standard. A metal baffle filter shall be provided.
- .5 One (1) 60W Incandescent Shatterproof bulb or equivalent LED Hood light shall provide lighting on the range below.
- .6 The Hood shall integrate with the cooking equipment to deactivate the cooking equipment in the event of a discharge or system fault code.
- .7 Kitchen ventilation Hood shall be recirculating or exhaust only and cover a domestic range in commercial environments used for light duty cooking purposes only.



- .8 The Hood shall be ICC evaluated and certified as compliant with International Mechanical Code (IMC), International Fire Code (IFC), and Uniform Mechanical Code (UMC).
  - .1 If provided with a fan, the fan shall be UL 507 listed or equivalent.
- .9 The Fire Suppression Hood shall be listed by ETL to the standards of the UL Subject 300A. Hood shall be configured as wall style (supplied with wall mounting bracket).
- .10 Hood shall include factory-installed UL Subject 300A fire suppression system, including environmental monitoring, wire rope, fail-safe fusible links and mechanical actuation. No electronic detection or actuation shall be accepted.
- .11 Fire suppression shall be a fail-safe, mechanical, method and consist of three fusible links (212° for 30", 280° for 36"), temperature switches that monitor the cooking surface and upon reaching the first set-point, send a signal to turn the fan ON, at the second set point sends a signal to maintain the fan ON, while also sending a signal to shut OFF power to the range and sounding a local alarm. When the set point of the fusible links is reached, the tension on the actuator paddle releases pushing down on the actuator of the suppression tank; expelling the wet chemical agent from the pre-charged tank, a signal is sent to shut OFF power to the range and a local and building fire alarm (when connected) will be activated.
- .12 Tank pressure shall be monitored using tank pressure switch and a fault will cause the system alarm to sound and the LED status light will simultaneously flash four times. Pressure gauge indicating the tank pressure will be visible on the front of the hood. Mirrors to access the gauge shall not be acceptable.
- .13 All fire suppression and control components must be easily accessible by dropping the Hood into a service position to allow for service without removing the Hood from the wall. Thumb screws shall be utilized to hold the Hood into place for normal operation. No latches are acceptable.
- .14 Hood system shall be provided with a gas (3/4 inch), electric, or dual fuel disconnect supplied with plug and play cable that will shut down the power to the stove in the event of a system monitored condition occurring.
- .15 Fuel disconnect shall be field connected directly to the Hood via factory-provided plug and play cables. Prior to a fire suppression release, the shut off device shall be responsible for disabling the range upon detecting a high temperature. Gas disconnect (if provided) shall include a 3/4-inch gas valve supplied with plug and play cable and a 120VAC control receptacle is available upon request. Other electric disconnect receptacle types are also available upon request.
- .16 When governed by NFPA101 compliance Hood must include: a minimum of 500 CFM fan, interlocked (password protected) appliance disconnect with timed-automatic range deactivation and manual pull station.
  - .1 Pull station shall be a mechanical pull station. Electronic pull station is not acceptable.

- .2 Password protected access will be mounted remotely. Hood mounted password access is not acceptable. R. User controls shall be provided to control fan and lights. A Hood mounted touchscreen is not acceptable. The Hood or System status LED and audible alarm may be used to determine any faults within the system. All Hood controls must be accessed by switches and potentiometers on the Hood itself unless supplied with an ADA Switch with factory provided plug and play cable or controlled in conjunction with a touchscreen that is mounted remotely.
- .17 The Hood system shall be equipped with either a factory-supplied integral fan, factory-supplied external fan, or fan by others with manufacturer provided relay. Integral fan options include either front recirculating or rear discharge.
  - .1 Front recirculating style shall include an easily accessible charcoal filter and opening in the front of the Hood for filtering the exhaust air before discharging back into the space. Rear discharge style shall direct the air to exit the back of the hood, to discharge through a wall to the outside.
  - .2 External fan options include either a factory-provided inline fan (with plug and play cable), wall mount fan, roof fan or fan by others option with a top discharge Hood configuration. Top discharge style shall direct the air to exit the top of the hood, to discharge through a roof or wall to the outside. All factory provided fan options shall be listed to UL 507 standards.
- .18 Fire alarm dry contacts shall be provided.
- .19 Check, Test and Balance:
  - .1 The kitchen exhaust system shall be inspected, tested and balanced by a qualified contractor. The contractor shall ensure proper and satisfactory operation of the kitchen exhaust system and shall provide a written and detailed report of this check, test and startup to the Engineer and Owner.
- .20 Design Make: DENLAR D1000.
- .21 Warranty: Hood shall have a three-year product only warranty. Warranty does not include labor.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 The entire packaged kitchen exhaust hood shall be installed by qualified contractors meeting any licensing criteria in the jurisdiction they are installing.

#### **3.2 FIRE SUPPRESSION SYSTEM**

- .1 Ensure that fire suppression is properly installed and operational. Perform manufacturer recommended and required tests to ensure proper function.

**3.3            WARRANTY**

- .1      Warranty Start Date:
  - .1      Warranty period starts as of the date of Ready for Takeover.
  - .2      Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2      Warranty Duration:
  - .1      Two (2) year warranty period applies.
- .3      Warranty Coverage:
  - .1      Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA).
  - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .2 Canadian Gas Association (CGA).
  - .1 CAN1-3.1, Industrial and Commercial Gas-Fired Package Boilers.
  - .2 CSA-B149.1, Natural Gas and Propane Installation Code.
- .3 American National Standards Institute (ANSI).
  - .1 ANSI Z21.13, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .4 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV.

**1.2 BOILER SYSTEM LAYOUT ON FLOOR**

- .1 Pre-planning of the boiler room system must be done prior to any new construction in the boiler room beginning. The contractor shall provide a full scale markup of the boiler system on the floor of the boiler room. The markup shall be in various coloured chalk and shall include all the components/equipment of the boiler system.
  - .1 Housekeeping pad sizes/locations.
  - .2 Floor/hub drain locations.
  - .3 Vent/chimney stack locations and locations thru roof.
  - .4 Boiler positions (including burner & front door swing – depending on type of boiler).
  - .5 Rough locations and routing for heating supply/return headers and branch piping.
  - .6 Location of gas train (compared to boiler access/door swing) so gas can be disconnected from one or two unions.
  - .7 Locations for pumps, air separator, sink, eyewash, expansion tanks, etc.
  - .8 Locations for chemical treatment pot feeder assembly and makeup water assembly.
  - .9 Coordinate with the electrician and include markup locations for starters, panels, VFDs, etc.
  - .10 Location of unistrut supports where needed to route wiring or mount piping or equipment.
  - .11 Location of BAS controls & panels.

- .2 Markup shall be reviewed with the consultant and owner prior to new installations starting. Changes or adjustments of the layout will be made with chalk during the review.
- .3 Contractor to provide multiple photos of the final chalk layout.

### **1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate the following:
  - .1 Capacities of selected model
  - .2 General arrangement showing terminal points, instrumentation test connections.
  - .3 Clearances for operation, maintenance, servicing, cleaning.
  - .4 Piping hook-ups.
  - .5 Equipment electrical drawings.
  - .6 Burners and controls.
  - .7 All miscellaneous equipment, including low loss header and boiler circulation pumps.
  - .8 Flame safety control system.
  - .9 Breeching and stack configuration.
  - .10 Warranty information.
- .3 Engineering data to include:
  - .1 Boiler efficiency at 100%, of design capacity.
  - .2 Radiant heat loss at 100% design capacity.
  - .3 Water side pressure drop curve
  - .4 Certificate of Product Rating: AHRI Certification indicating thermal efficiency, combustion efficiency, materials of construction, input and gross output.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit operation and maintenance data for incorporation into manual specified in general requirements.

### **1.5 CERTIFICATION**

- .1 Manufacturer's Certification: The boiler manufacturer shall certify the following:
  - .1 The products and systems furnished are in strict compliance with the specifications.
  - .2 The boiler, burner and other associated mechanical and electrical equipment have all been properly coordinated and integrated to provide a complete and operable boiler.
  - .3 ASME certification.

- .4 CSA (AGA/CGA) certification.
- .5 The specified factory tests have been satisfactorily performed.
- .6 The equipment furnished contains inter-changeable parts with the specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Furnish the number of factory "packaged" low pressure hot water boilers indicated on the drawings. Each factory "packaged" boiler shall be complete with all components, accessories and appurtenances necessary for a complete and operable boiler as hereinafter specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.
- .2 Capacity: Refer to schedules.

### **2.2 PERFORMANCE CRITERIA**

- .1 Boiler shall comply with ASME Section IV for 345 kPa (50 psig) (max 98°C/200°F).
- .2 Boiler relief valve setting shall be 345 kPa (50 psig) max.
- .3 Maximum allowable water temperature shall be 210°F
- .4 Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5" w.c. to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14" w.c.
- .5 Ambient air temperature shall be assumed to range from 10°C (50°F) to 32°C (90°F) with an average of 21°C (70°F).
- .6 Power voltage shall be 120vac, 1-phase, 60 hertz. Breaker size shall be 15 Amps. Control voltage shall be 24 vac (transformer to be supplied by boiler manufacturer).
- .7 Boiler shall be suitable for use with either water or glycol solutions.

### **2.3 FRAME AND ENCLOSURE**

- .1 Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from carbon steel. The outer casing shall be finished, inside and out, with a powder coat finish.
- .2 The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure an outer casing temperature of not more than 37°C (100°F) when the boiler is operated at full rated load.
- .3 Front cover shall be removeable for proper service. Provide additional access panels as required to other components to aid serviceability.
- .4 Provide appropriate NEMA 250, Type 1 enclosure for controls components.

## **2.4 HEAT EXCHANGER**

- .1 Fire-tube stainless steel heat exchanger with secondary condensing section.
- .2 The boiler shall have non-metallic condensate collector to capture condensate from both the vent system and heat exchanger.

## **2.5 BURNER**

- .1 The combustion chamber will be sealed and located at the top/front of the boiler and be of counter flow design.
- .2 Burner shall be premix combustion type, made with stainless steel and a woven metal fiber out covering to provide a wide range of modulating fire rates.
- .3 The boiler shall be equipped with a variable speed combustion blower system capable of modulating the boiler firing rate.
- .4 The boiler shall be equipped with a device capable of controlling the air/fuel ratio through a 10 to 1 turn down ratio.
- .5 **Provide combi series with integrated stainless steel plate heat exchanger for instantaneous DHW production where indicated in schedules.**

## **2.6 NEUTRALIZING VESSEL**

- .1 Rotationally molded low density polyethylene vessel with minimum 3" diameter fill/access openings at each end, 3/4" diameter inlet and outlet pipe connections. Provide all necessary mounting hardware. Unit (or units if more than 1 is required) is to be sized to neutralize capacity of condensate from boiler, before being drained to sewer system. Vessel to be sized to suit condensate produced by the boiler.
- .2 Provide initial charge of limestone and store one (1) additional charge where directed on site.
- .3 Acceptable materials: From boiler manufacturer.

## **2.7 IGNITION SYSTEM**

- .1 Each boiler shall be equipped for direct spark ignition.

## **2.8 GAS VALVE ASSEMBLY (MODULATING)**

- .1 Each boiler shall be provided with an integral gas valve assembly. The main gas valve assembly shall be factory assembled, piped, and wired. Each gas valve shall include at least the following:
  - .1 One (1) manual shutoff valve (gas inlet connection).
  - .2 Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.
  - .3 Modulating Air – Gas ratio control (maximum inlet pressure 14" w.c.).
  - .4 One (1) low gas pressure switch (manual reset).
  - .5 One (1) high gas pressure switch (manual reset).

- .6 Two (2) pressure test ports.
- .7 Union connection to permit burner servicing.

## **2.9 COMBUSTION AIR CONTROL SYSTEM (DIGITAL)**

- .1 Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:
  - .1 The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve, which will modulate to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.
  - .2 One (1) low airflow differential pressure switch to insure that combustion air is supplied.
  - .3 High exhaust back pressure switch.

## **2.10 BOILER PUMPS**

- .1 Capacity: To suit boiler flow rate and pressure losses through the heat exchanger and piping to the primary system.
- .2 Provide all pump accessories (strainers, balancing valves etc.)
- .3 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 105°C (220°F) continuous service.
- .4 Motor: 120v/208v /1Ph/60hz, drip-proof, with thermal overload protection.
- .5 Supports: Provide as recommended by manufacturer.
- .6 Acceptable materials:
  - .1 Grundfos
  - .2 Bell & Gossett
  - .3 Armstrong
  - .4 Taco
- .7 Install to manufacturer's recommendations and requirements and ANSI/ASME boiler and pressure vessel code section IV.
- .8 Wired to operate from boiler electrical system in unison with boiler.
- .9 Install strainers on the inlet piping of each boiler.

## **2.11 VENTING**

- .1 Boiler(s) exhaust vent must be capable of carrying boiler flue gases to the building exterior and terminate with a boiler manufacturer approved vent kit. Boiler exhaust vent shall be thru roof or sidewall. Refer to drawings.
- .2 Boiler(s) intake must be capable of using outside air piped directly to boiler for combustion. Inlet and termination of these vents must be terminated either through the roof or sidewall terminations. Refer to drawings.



- .3 Providing manufacturer shall examine the plans to ensure the provided boiler's maximum vent length is suitable for the vent routing indicated on the plans.
- .4 Installing contractor is responsible to ensure installed venting equivalent length complies with maximum allowed length by manufacturer.
- .5 Venting material shall be in accordance with manufacturer installation guidelines.

## **2.12 MULTIPLE BOILER SYSTEM CONTROL/CONTROL PANEL**

- .1 Provide a complete control system for all boilers, boiler circulation pumps and the main system pumps.
- .2 Control system shall be capable of modulating boilers together and controlling the on/off and staging of all boilers to maintain Hot Water Supply Set Point. Provide prebuilt logic for both firing rate threshold staging and parallel modulation.
- .3 Controller shall be capable of having hot water supply temperature set point reset based on outdoor air temperature and night setback. Boiler manufacturer shall provide outdoor air temperature sensor to complete the system. The outdoor air sensor required in cases when BAS system has failed.
- .4 Provide all necessary relays, control wiring and components for a complete operational system.
- .5 Provide all necessary flow switches, differential switches and temperature sensors for installation in the HWS/HWR mains.
- .6 Control system shall be factory built and supplied with boilers. After market control systems are not acceptable.

## **2.13 BACNET INTEGRATION**

- .1 The boiler shall include BACNet integration.
- .2 Through digital integration the following minimal information shall be controlled and visible:
  - .1 Writeable Points
    - .1 Hot Water Supply Temperature Set Point
    - .2 Hot Water Return Temperature Set Point
    - .3 Fire rate
    - .4 System/Boiler Pump Command
    - .5 Boiler Enable/Disable
    - .6 Lead/Lag Control (enable and settings)
    - .7 Emergency Shut down
  - .2 Readable Points
    - .1 Hot Water Supply Temperature
    - .2 Hot Water Return Temperature
    - .3 Fire Rate Feedback
    - .4 Failure/Alarm

- .5 Cycle/Run Time totals
- .6 Flow verification (if equipped with internal flow switch)
- .7 Pump status
- .8 Combustion efficiency
- .9 Various operating status' as available in standard BACNet integration offering
- .3 Lock out and error codes shall be transmitted to the BAS and be readable at the Operator Workstation so that error codes can be remotely accessed and reviewed prior to site visit. Manufacturer shall provide correct controller to provide this functionality.

#### **2.14 BOILER TRIM**

- .1 Boiler shall be provided with all necessary trim. Boiler trim shall be as follows:
  - .1 Safety relief valve shall be provided in compliance with the ASME code. Contractor to pipe to acceptable drain.
  - .2 Thermometer: 115mm diameter range 10 to 150C
  - .3 Pressure gauge: 90mm diameter complete with shut off cock
  - .4 Primary low water flow fuel cutoff (probe type with manual reset).
  - .5 High limit water temperature controller to stop burner operation at excess water temperature (shall be manual reset).
  - .6 Operating temperature control to control the sequential operation of the burner.
  - .7 Separate inlet and outlet water temperature sensors capable of monitoring flow.
  - .8 isolating valve: on supply and return connections.
  - .9 Exhaust temperature sensor.
  - .10 Drain Valve: NPS 1 ½ inch.
- .2 Neutralizing tank
  - .1 Rotationally molded low-density polyethylene sump. Capacity: 7 gal, 15" diameter x 15" tall, 2" inlet.
  - .2 15 mm (1/2") extruded high-density polyethylene top and inspection ports complete with neoprene or epdm gasket to suit. Provide 3/32 steel top and extension for in floor installation.
  - .3 Series 60 high-density polyethylene fittings.
  - .4 Provide initial charge of limestone and store one (1) additional charge where directed on site.

#### **2.15 ACCESSORIES**

- .1 Low Loss Header c/w insulation package
- .2 **BACNet Card**

**2.16 ACCEPTABLE MATERIALS**

- .1 Lochinvar
- .2 Viessmann Manufacturing Company
- .3 No Alternates

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Contractor shall install boilers in accordance with all manufacturer installation instructions and as indicated on the drawings.
- .2 Meet all local and applicable codes of installation.
- .3 Maintain manufacturer's recommended service clearances on all sides of the equipment.
- .4 Supplying contractor shall install all shipped loose equipment.
- .5 Supplying contractor shall be responsible for all interconnecting electrical control and power wiring, including high voltage wiring between boiler and isolation valve actuator.
- .6 Install boilers on cast-in-place concrete housekeeping pads.
- .7 Install strainers on the inlet piping of each boiler.

**3.2 QUALITY CONTROL**

- .1 Boiler shall be provided by a firm regularly engaged in the manufacture of condensing hydronic boilers with welded steel pressure vessels, whose products have been in satisfactory use in service for not less than ten (10) years.
- .2 Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME "H" stamp.
- .3 Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.
- .4 The manufacturer shall have a factory authorized service training program, where boiler technicians can attend a training class and obtain certification to perform start-up, maintenance and basic troubleshooting specific to the product line. There shall be a minimum of 4 trained technicians within 100 km of the job site.
- .5 Provided equipment shall be of the type, design and size that the manufacturer currently offers for sale and must appear in the manufacturer's current catalogue.

### **3.3 FIELD TESTING**

- .1 The boiler manufacturer shall field test the following:
  - .1 Boiler and burner interlocks.
  - .2 Actuators.
  - .3 Valves.
  - .4 Controllers.
  - .5 Gauges.
  - .6 Thermometers.
  - .7 Pilot lights.
  - .8 Switches.
  - .9 LCD Screen Functional Test
  - .10 Any malfunctioning component shall be replaced.

### **3.4 DEMONSTRATION AND TRAINING**

- .1 Provide minimum 2 hours on site training to owner's representative, including all safety procedures, maintenance procedures, control operations and diagnostic procedures.
- .2 Training shall be provided by a factory trained service technician.
- .3 Training shall occur at the installed location.

### **3.5 TSSA INSPECTION**

- .1 This contractor shall make application, arrange, and pay for a TSSA inspection of the boiler plant and associated equipment installed under the contract at the completion of the project and prior to final acceptance of the system.
- .2 Provide a copy of the TSSA report in the maintenance manuals.
- .3 Provide copy of the TSSA report to the consultant prior to occupancy.

### **3.6 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
  - .2 Contractor hereby warrants the burner against defective material or workmanship for five (5) years.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME Boiler and Pressure Vessel Code, Section VIII Pressure Vessels.
- .3 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .4 AHRI Standard Certification

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with General Requirements.
- .2 Indicate: manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.

**1.3 MAINTENANCE MATERIALS**

- .1 Provide maintenance materials in accordance with General Requirements.
- .2 Supply following spare parts:
  - .1 Head gaskets.

**1.4 MAINTENANCE DATA**

- .1 Provide maintenance data for incorporation into manual specified in General Requirements.

**Part 2 Products**

**2.1 BRAZED PLATE HEAT EXCHANGERS**

- .1 General
  - .1 Fluids: as indicated, single pass design, double wall
  - .2 Designed, constructed, and tested in accordance with ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, CSA B51 and provincial pressure vessel regulations.
- .2 Plate material: 316L stainless steel
- .3 Braze material: copper
- .4 Fouling factor: water side 0.001.
- .5 Capacity: as indicated
- .6 Mounting supports: steel saddle on floor mounted frame
- .7 Acceptable material:
  - .1 LG (Match ASHP Equipment)

## **2.2 SPARE PARTS**

- .1 Refer to Section 20 05 11 Mechanical Work Requirements.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.
- .4 Brazed plate and coaxial heat exchangers are not cleanable, so the strainer mounted ahead of these devices is very important, including the proper mesh strainer.
- .5 Provide strainers ahead of all heat exchangers.
- .6 Strainer mesh shall be selected to be only 75% size of the smallest opening in plate exchanger or less as recommended by the manufacturer.
- .7 Consult heat exchanger manufacture for strainer sizing and provide as recommended.

### **3.2 APPURTENANCES**

- .1 Install with safety relief valve piped to drain hose bib drain valve.
- .2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

### **3.3 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA B52, Mechanical Refrigeration Code.
- .3 EPS 1/RA/2, Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .4 C.1 CSA B52-2023, Mechanical Refrigeration Code
- .5 C.2 CAN/CSA-C22.2 No 60335 Safety of Household and similar electrical appliances – Heat Pumps, Air-conditioners and dehumidifiers

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general conditions.
- .2 Indicate major components and accessories including sound power levels of units.
- .3 Type of refrigerant used.

**1.3 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into manual specified in general conditions.

**Part 2 Products**

**2.1 GENERAL**

- .1 System components:
  - .1 Type 1
    - .1 Outdoor air-cooled condensing units.
    - .2 Indoor air cooling horizontal ceiling mounted unit.

**2.2 TYPE 1 INDOOR HORIZONTAL CEILING UNIT**

- .1 The cabinet and chassis shall be constructed of heavy gauge, painted furniture steel. The cabinet shall be designed for easy installation and service access from the front only.
- .2 Air distribution system shall be constructed with a quiet, direct-drive fan assembly equipped with multiple double-inlet blowers, self-aligning sleeve bearings, and lifetime lubrication. Fan motor shall be permanent-split capacitor, high efficiency type, equipped with two speeds for air flow modulation. Dehumidification shall utilize the lower fan speed.
- .3 Air filters shall be the cleanable foam type. They shall be easily removable from the front of the system by means of quarter-turn fasteners and shall not require system shutdown for service.

- .4 Microprocessor based integral control system shall be factory assembled, wired into the system cabinet and tested prior to shipment. Controls shall be easily accessible from the front of the system. The controls shall include an LCD custom display providing a continuous display of operating status and alarm condition. An 8 key membrane keypad for setpoint/program control, unit on/off, and fan speed shall be located below the display.
- .5 Auto restart feature shall automatically restart the system after a power failure.
- .6 Control shall have two temperature control setpoints for cooling and heating functions with a minimum 1C° (2F°) differential between them. The control shall automatically switch from cooling to heating modes based on return air conditions. The temperature control setpoint range shall be 16°C to 29°C (60°F to 85°F).
- .7 Units shall have humidity control: The control shall have two humidity control setpoints for humidification and dehumidification functions with a minimum 4% RH differential between them. The control shall automatically switch from humidifying to dehumidifying based on return air conditions.  
Humidity control setpoint range shall be 20% RH to 80% RH.
- .8 Control shall be programmable on a daily basis or on a 5 day/2 day program schedule. It shall be capable of accepting 2 programs per day.  
Control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 10 to 90 seconds.  
The control shall be capable of displaying temperature values in °F or °C.
- .9 LCD display shall provide an on/off indication, fan speed indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity indication. The monitoring system shall be capable of relaying unit operating parameters and alarms to the Liebert SiteScan monitoring system.
- .10 Alarms: Control system shall monitor unit operation and activate an audible and visual alarm for the following field adjustable conditions.
  - .1 High Temperature [max 32°C (90°F)]
  - .2 Low Temperature [min 2°C (35°F)]
  - .3 High Humidity (max 85% RH)
  - .4 Low Humidity (min 15% RH)
  - .5 The control shall be capable of disabling any alarm if required.
- .11 Electric reheats shall be low-watt density, tubular elements and shall include agency approved safety switches to protect the system from overheating. The capacity of the reheat coils shall be 6C° (10F°) rise controlled in 1 stage.
- .12 The evaporator coil shall have adequate face area, and four (4) rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of 152 m/min (500 ft/min). Refrigerant flow shall be controlled by an externally equalized thermostatic expansion valve. The coil shall be provided with a galvanized steel drain pan.



- .13 The refrigeration system shall consist of a hermetic compressor with vibration isolating springs, high pressure safety switch, liquid line filter/drier, and a compressor crankcase heater. Refrigeration components shall be located in remote condensor unit.
- .14 Pre-charged refrigerant line sets shall be provided by Liebert in proper lengths for application.
- .15 Electronically controlled steam-generating humidifier factory piped, mounted and wired to the integral control system. The steam generator shall provide dry steam to the bypass air around the evaporator coil.  
Controls for the humidification system shall include: High and low humidity setpoints, automatic water feed and drain valves.
- .16 Unit Selection
  - .1 Capacity:
    - .1 Refer to schedule.
  - .2 Electrical Requirements:
    - .1 Unit electrical power shall be single-point connection.
    - .2 Unit control circuit shall contain a 24-v transformer for unit control.
  - .3 Refrigerant: A1 or A2L classification.
  - .4 Acceptable material:
    - .1 Leibert: Minimate MMD60E
    - .2 Ecosaire

## **2.3 OUTDOOR AIR-COOLED CONDENSER UNIT**

- .1 Air Cooled Systems
  - .1 The air cooled condenser shall be the low profile, show speed, multiple direct drive, propeller fan type. The condenser shall balance the heat rejection of the compressor at 95 °F ambient.  
The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for vertical air discharge.
  - .2 Unit shall be low profile style.
  - .3 Provide centrifugal or axial fan.
  - .4 The condensing unit shall be factory tested, charged with refrigerant, sealed and be capable of being connected to the evaporator section using pre-charged refrigerant line sets. No piping, brazing, dehydration or charging shall be required. Condensor shall be designed for 35°C (95°F) ambient and be capable of operation to -29°C (-20°F).
  - .5 The condensing unit shall be designed to operate at a sound level less than 58 dba.

.2 Winter Control System

- .1 The winter control system for the air cooled condenser shall be Lee-Temp. The Lee-Temp system shall allow start-up and positive head pressure control with ambient temperatures as low as 30°F. The package shall include the following components for each refrigeration circuit: insulated receiver, pressure relief valve, head pressure three-way control valve, and rotalock valve for isolating the refrigerant charge. The receiver shall be factory insulated and mounted ready for the field connection to the air cooled condenser. The Lee- Temp heater shall require a separate power supply of 120 volt, single phase. Provide a disconnect switch factory mounted and wired to the condenser control panel, accessible from the exterior

.3 Outdoor Unit

- .1 Capacity:  
.1 Refer to schedule.  
.2 Electrical Requirements (two power sources required):  
.1 Refer to schedule.

**2.4 REFRIGERANT**

- .1 Refrigerant shall be A1 or A2L Classified.  
.2 Refrigerant holding charge shall be applied at factory.  
.3 Refrigeration circuit components shall include liquid line service valve, suction line service valve, liquid filter drier, a full charge of compressor oil, a holding charge of refrigerant and leak mitigation solenoid valves.  
.4 The system shall be equipped with minimum **one** compressor and independent refrigeration circuit to limit the volume of refrigerant that may be released in the event of a leak.  
.5 The maximum charge allowed per circuit is 3 lbs. Provide additional compressors/circuits if required to keep charge below this value.  
.6 The maximum allowed releasable refrigerant volume is 3 lbs. Provide leak detection and solenoid valves to limit release volume from each circuit.  
.7 Refrigerant coils with multiple compressors shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions. (split face coils are not acceptable). Provision for use of thermal expansion valves must be included for variable air volume applications.  
.8 Provide refrigerant leak detectors for installation in served space. Detector shall close refrigeration leak safety valve to limit charge released into space/atmosphere.

- .9 The Refrigerant detection system shall meet the requirements of CSA B52 and have the following functionality:
  - .1 Utilize a set point, nonadjustable in the field, to generate a digital output signal to initiate mitigation actions to both internal safeties and external components in the ductwork (dampers, electric coils etc.). Signal shall be generated in not more than 30 seconds from sensor exposure to refrigerant concentration of 25% LFL (+0%, -1%)
  - .2 Field calibration of the system is not allowed.
  - .3 Be capable of detecting the refrigerant used in the system.
  - .4 Have self diagnostics
  - .5 Energize circulation fans in the event of a leak detection or failed self-diagnostics.
  - .6 Have a digital output signal for monitoring by other systems
  - .7 Activate refrigerant safety shut off valves in the event of a leak being detected.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 Install five (5) complete systems as indicated complete with provision for an additional future unit complete with all humidifier and refrigeration piping rough-in and retention curb to manufacturers' recommendations.
- .2 Install precision air conditioning units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- .3 Run drain line from cooling coil condensate drain pump to terminate over nearest floor drain.
- .4 Provide retention curb under each unit as indicated.
- .5 Provide cold water line to unit including future unit complete with shut off valve. Provide cap at future unit.

#### **3.2 ELECTRICAL WIRING**

- .1 Install and connect electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

#### **3.3 PIPING CONNECTIONS**

- .1 Install and connect devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

**3.4 EQUIPMENT PREPARATION AND START-UP**

- .1 Provide services of manufacturer's authorized factory trained mechanic to set and adjust equipment for operation as specified.
- .2 Start up mainframe coolant units in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements.
- .3 Provide results in operation and maintenance manuals

**3.5 WATER LEAK DETECTION SYSTEM**

- .1 Install system to manufacturers' requirements.

**3.6 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
  - .2 Contractor hereby warrants refrigeration compressors for five (5) years.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM C553, Mineral Fiber Blanket, Thermal Insulation for Commercial and Industrial Applications.
- .3 CSA B52, Mechanical Refrigeration Code.
- .4 EPS 1/RA/2, Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general conditions.
- .2 Indicate major components and accessories including sound power levels of units.
- .3 Type of refrigerant used.

**1.3 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into manual specified in general conditions.

**Part 2 Products**

**2.1 GENERAL**

- .1 System type:
  - .1 Air flow arrangement: horizontal
  - .2 Cooling: direct expansion
  - .3 Condensing: air cooled

**2.2 OUTDOOR HEAT PUMP UNITS**

- .1 General:  
Factory-assembled, single piece, air-cooled condensing unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge (R-22), and special features required prior to field start-up. Unit shall be rated in accordance with ARI Standard and be CSA approved.
- .2 Unit Cabinet:
  - .1 Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a prepainted baked enamel finish.
  - .2 A heavy gage roll-formed perimeter base rail with forklift slots and lifting holes shall be provided to facilitate rigging.

- .3 Fans:
  - .1 Condenser fans shall be direct driven, propeller-type, discharging air vertically upward.
  - .2 Fan blades shall be balanced.
  - .3 Condenser fan discharge openings shall be equipped with PVC coated steel wire safety guards.
  - .4 Condenser fan and motor shaft shall be corrosion resistant.
- .4 Compressor:
  - .1 Compressor shall be of the hermetic reciprocating type or semi-hermetic reciprocating type.
  - .2 Compressor shall be mounted on vibration isolators.
  - .3 Compressors shall include overload protection.
- .5 Condenser Coil:
  - .1 Condenser coil shall be air-cooled and circuited for integral subcooler.
  - .2 Coil shall be constructed of aluminum fins (copper fins optional) mechanically bonded to internally grooved seamless copper tubes which are then cleaned, dehydrated, and sealed.
- .6 Controls and Safeties:
  - .1 Minimum control functions shall include:
    - .1 Control wire terminal blocks.
    - .2 Five-minute recycle protection to prevent compressor short-cycling.
    - .3 Compressor lockout on auto-reset safety until reset from thermostat.
  - .2 Minimum Safety devices which are equipped with automatic reset (after resetting first at thermostat), shall include:
    - .1 High discharge pressure cutout.
    - .2 Loss-of-charge cutout.
- .7 Electrical Requirements:
  - .1 Voltage and capacity as noted.
  - .2 Unit electrical power shall be single-point connection.
  - .3 Unit control circuit shall contain a 24-V transformer for unit control.
- .8 Capacity: As noted.
- .9 Provide the following:
  - .1 Hail Guard Package.
  - .2 Winter Start Package.

.3 Acceptable materials:

- .1 LG
- .2 Carrier 38CKC
- .3 Trane
- .4 Lennox

**2.3 INDOOR DX COOLING COIL**

- .1 General: Horizontal direct-expansion cooling coil with casing as indicated
- .2 Cooling coil shall be constructed with aluminum plate fins mechanically bonded to nonferrous tubing with all joints brazed.
- .3 The casing of encased coils shall be insulated and finished with baked enamel or equivalent corrosion-resistant surface. The casing material shall be galvanized steel. The coil casing shall allow space for attaching field-supplied thermostatic expansion valve.
- .4 Capacity: Refer to Schedules.
- .5 Acceptable materials:
  - .1 LG
  - .2 Mitsubishi
  - .3 Daikin
  - .4 Carrier
  - .5 Lennox.

**2.4 WALL HUNG FAN COIL UNIT**

- .1 Indoor, direct-expansion, wall mounted fan coil, complete with cooling coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Unit shall be furnished with integral wall-mounting bracket and mounting hardware.
- .2 Cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.
- .3 Fan shall be tangential direct-drive blower type with air intake at the upper front face of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided.
- .4 Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap and auxiliary drip pan under coil header.
- .5 Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 3-speed.

- .6 Controls shall consist of a microprocessor based control system which shall control space temperature, determine optimum fan speed, and run self diagnostics. The temperature control range shall be from 18°C to 29°C (64°F to 84°F). The unit shall have the following functions:
  - .1 An automatic restart after power failure at the same operating conditions as at failure.
  - .2 A timer function to provide a minimum 24-hour timer cycle for system Auto. Start/Stop.
  - .3 Temperature-sensing controls shall sense return-air temperature. Indoor-air high discharge temperature shutdown shall be provided.
  - .4 Indoor coil freeze protection.
  - .5 Wall mounted thermostat to enter set points and operating conditions.
  - .6 Auto Stop features shall have integral setback control.
  - .7 Automatic airsweep control to provide on or off activation of airsweep louvers.
  - .8 Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
  - .9 Fan speed control shall be user-selectable: high, medium, low, or microprocessor automatic operation during all operating modes.
  - .10 A time delay shall prevent compressor restart in less than three minutes.
- .7 Filter track with factory-supplied cleanable filters.
- .8 Capacity: Refer to schedules.
- .9 Acceptable materials: To match interior unit manufacturer.

## **2.5 REFRIGERANT LEAK DETECTION SYSTEM**

- .1 The maximum charge allowed per circuit is 3 lbs. Provide additional compressors/circuits if required to keep charge below this value.
- .2 The maximum allowed releasable refrigerant volume is 3 lbs. Provide leak detection and solenoid valves to limit release volume from each circuit.
- .3 Refrigerant coils with multiple compressors shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions. (split face coils are not acceptable). Provision for use of thermal expansion valves must be included for variable air volume applications.
- .4 Provide refrigerant leak detectors for installation in served space. Detector shall close refrigeration leak safety valve to limit charge released into space/atmosphere.
- .5 The Refrigerant detection system shall meet the requirements of CSA B52 and have the following functionality:
  - .1 Utilize a set point, nonadjustable in the field, to generate a digital output signal to initiate mitigation actions to both internal safeties and external components in the ductwork (dampers, electric coils etc.). Signal shall be generated in not more than 30 seconds from sensor exposure to refrigerant concentration of 25% LFL (+0\$, -1%)



- .2 Field calibration of the system is not allowed.
- .3 Be capable of detecting the refrigerant used in the system.
- .4 Have self diagnostics
- .5 Energize circulation fans in the event of a leak detection or failed self-diagnostics.
- .6 Have a digital output signal for monitoring by other systems
- .7 Activate refrigerant safety shut off valves in the event of a leak being detected.

## **2.6 REFRIGERANT**

- .1 Refrigerant shall be A1 or A2L Classified.
- .2 Refrigerant holding charge shall be applied at factory.
- .3 Refrigeration circuit components shall include liquid line service valve, suction line service valve, liquid filter drier, a full charge of compressor oil, a holding charge of refrigerant and leak mitigation solenoid valves.
- .4 The system shall be equipped with independent refrigeration circuits to limit the volume of refrigerant that may be released in the event of a leak to maximum 6 lbs.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Install as indicated, to manufacturers' recommendations.
- .2 Manufacturer to certify installation.
- .3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.
- .4 Provide concrete pad complete with 100 mm x 100 mm x 20 mm (4" x 4" x 3/4") neoprene type vibration isolation.

### **3.2 EQUIPMENT**

- .1 Preparation and Start-Up
  - .1 Provide services of manufacturer's authorized factory trained mechanic to set and adjust equipment for operation as specified.
  - .2 Provide results in operation and maintenance manuals

### **3.3 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
  - .2 Contractor hereby warrants refrigeration compressors for five (5) years.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM C553, Mineral Fiber Blanket, Thermal Insulation for Commercial and Industrial Applications.
- .3 CSA B52, Mechanical Refrigeration Code.
- .4 EPS 1/RA/2, Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

**1.2 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into manual specified in general conditions.

**1.3 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Mechanical General Requirements Section.
- .2 Indicate the following: complete specifications; wiring diagrams (showing all interconnections); weight; performance details.
- .3 Provide data for inclusion in the Operating and Maintenance manuals in accordance with Mechanical General Requirements Section.
- .4 Submittals shall provide piping network and length takeoffs, as well as the refrigerant charge for each system.
- .5 Shop drawings shall provide indication of all spaces that do not have sufficient dispersal volume to meet the refrigeration safety requirements of CSA B52.

**1.4 QUALITY CONTROL**

- .1 The system shall be provided by a manufacturer who has minimum 5 years experience in the manufacture of VRF systems designed for use in a climate zone similar to the installed location.
- .2 The manufacturer shall provide factory certified training to installing contractors on the system being provided to the project.
- .3 The manufacturer shall not ship equipment to the site until the installing contractor has completed the manufacturer's factory installation training.
- .4 The manufacturer shall periodically attend the site throughout construction to ensure the system is being installed in accordance with the manufacturer's installation instructions and the approved shop drawings. Verification of pipe routing, length of pipe, refrigerant charges etc. shall be completed to ensure compliance with the shop drawings.
- .5 Installing contractor shall submit proof of completion of installers training to consultant.

## **1.5 SYSTEM STARTUP**

- .1 Manufacturer shall complete startup of the systems.
- .2 Startup shall be completed by a certified technician if completed by a third party who has been contracted by the manufacturer. Provide proof of training to the consultant.
- .3 Startup by the installing contractor is not allowed.

## **Part 2 Products**

### **2.1 HEAT PUMP SYSTEM**

- .1 Product Design
  - .1 LG Multi V 5 heating and cooling system shall be an air cooled system allowing user to configure in the field a heat pump or a heat recovery system consisting of one to three outdoor unit modules, conjoined to make a 6-42 ton single refrigerant circuit.
    - .1 Heat recovery systems, employing three pipes, shall be connected to Heat recovery (heat recovery) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s) at various capacities as required to satisfy their zone requirements.
    - .2 Heat pump systems shall require two pipes, simultaneous heating and cooling shall not be supported. The heat recovery system shall consist of three pipes, liquid, suction and hot gas pipes. Heat recovery systems operating at 0°F that cannot deliver single phase superheated refrigerant vapor at a minimum of 162°F while operating in the heating mode shall not be acceptable.
  - .2 All three-phase VRF heat pump and heat recovery outdoor units shall be from the same product development generation. Mixing of outdoor units from different development generations is not acceptable.
- .2 Operating Conditions
  - .1 Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions, operation outside of these conditions are possible and may involve non-continuous operations.
  - .2 Operating Ambient Air Conditions:
    - .1 Cooling: 5°F DB to 122°F DB
    - .2 Heating: -22°F WB to 61°F WB
    - .3 Cooling Based (ODU reversing valve in cooling position) Synchronous: 14°F DB to 81°F DB (Heat Recovery Operation Only)
    - .4 Heating Based (ODU reversing valve in heating position) Synchronous: 14°F WB to 61°F WB (Heat Recovery Operation Only)

.3 Electrical

- .1 All air source heat pump and heat recovery frame(s) shall be designed and electrically protected to maintain stable continuous compressor operation when provided with 575/60/3 power with the following specifications.
  - .1 575/60/3
  - .1 Voltage fluctuation of  $\pm 10\%$
  - .2 Voltage imbalance of up to two percent;
  - .3 Power surge of up to 5kA RMS Symmetrical.

.4 General Features

- .1 The air-conditioning system shall use R410A refrigerant.
- .2 Each system shall consist of one, two or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.
- .3 Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kits and field provided interconnecting pipe to form a common refrigerant circuit.
- .4 System shall have following frame configurations vs. capacity.
  - .1 6 to 20 ton units shall be a single frame only.
  - .2 22 to 34 ton units shall be dual frame only.
  - .3 36 to 42 ton heat recovery units shall be triple frame only
- .5 System shall employ self-diagnostics function to identify any malfunctions and provide type and location of malfunctions via fault alarms.
- .6 Field Provided Refrigerant Piping
  - .1 The refrigerant piping system shall be constructed using field provided ACR copper rated for the use with refrigerant R410A, de-hydrated pipe field engineered and assembled with manufacturer supplied Heat recovery unit(s) and Y- branches, as may be required, connected to multiple (ducted, non-ducted or mixed combination) indoor units to effectively and efficiently control the heat pump operation or simultaneous heating and cooling operation of the heat recovery VRF system. Other pipe materials, if used, shall perform, at a minimum, as well as that specified above, shall not have any adverse reactions, for example galvanic corrosion or branch to branch differential pressure drop, with any other components or materials also in use in the system and shall be installed per manufacturer's instructions.
  - .2 The unit shall be shipped from the factory fully assembled including internal refrigerant piping, inverter driven compressor(s), controls, temperature sensor, humidity sensor, contacts, relay(s), fans, power and communications wiring as necessary to perform both Heat Pump and Heat Recovery operations.

- .3 Each outdoor unit refrigeration circuit shall include, but not limited to, the following components:
  - .1 Refrigerant strainer(s)
  - .2 Check valve(s)
  - .3 Inverter driven, medium pressure vapor injection, high pressure shell compressors
  - .4 Liquid refrigerant cooled inverter PCB
  - .5 Oil separator(s)
  - .6 Accumulator /controlled volume receiver(s)
  - .7 4-way reversing valve(s)
    - .1 Vapor injection valve(s)
  - .8 Variable path heat exchanger control valve(s)
  - .9 Oil balancing control
  - .10 Oil Level sensor(s)
  - .11 Electronic expansion valve(s)
    - .1 Sub-cooler (s)
    - .2 Vapor Injection Valve(s)
  - .12 High and low side Schrader valve service ports with caps
    - .1 Service valves
- .7 Field Insulation:
  - .1 All refrigerant pipe, y-branches, elbows and valves shall be individually insulated with no air gaps. Insulation heat transfer resistance shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be installed in a compressed state at any point in the system.
  - .1 All joints shall be glued and sealed per insulation manufactures instructions to make a vapor tight assembly.
- .8 Microprocessor:
  - .1 Factory installed microprocessor controls in the outdoor unit(s), heat recovery unit(s), and indoor unit(s) shall perform functions to optimize the operation of the VRF system and communicate in a daisy chain configuration between outdoor unit and heat recovery unit(s) and indoor unit(s) via RS485 (shielded twisted wire pair) network. Control devices shall also be available to control other building systems as required from the VRF control system. DIO/AIO capabilities shall be available as well as a central controller to perform operation changes, schedules and other duties as required by this specification. Addition of separate building control system shall not be required. Other control devices and sequences shall be as specified in other sections of this project specification.

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- .9 Inverter PCB Cooling:
- .1 Cooling of the inverter PCB shall be conducted by way of high pressure, sub-cooled liquid refrigerant via heat exchanger attached to the inverter PCB. The full capacity flow of refrigerant shall pass through the heat exchangers to maximize the cooling effect of the PCBs and to aid in the evaporation process and capacity of the outdoor coil during the heating mode. The recovered heat of the PCBs must be used to enhance the overall heating process, other uses or dissipation of heat to ambient shall not be permitted.
- .10 Compressor Control:
- .1 Fuzzy control logic shall establish and maintain target evaporating temperature ( $T_e$ ) in cooling mode and condensing temperature ( $T_c$ ) in heating mode by Fuzzy control logic to ensure the stable system performance.
- .11 Initial Test Run (ITR) (Heating or Cooling) / Fault Detection Diagnosis (FDD) Code:
- .1 This control mode shall monitor and display positive or negative results of system initial startup and commissioning. Heating or Cooling ITR mode will be automatically selected. It shall monitor and provide performance metrics for the following, but not be limited to, refrigerant charge validation, auto-charge operation verification, refrigerant cycle stability, connection ratios, indoor unit status, error status, and number of indoor units connected. This commissioning specific control mode shall not replace the system error monitoring control system during normal operation.
- .12 BMS Integration:
- .1 The VRF system shall be able to integrate with Building Management Systems via BACnet™ IP gateway. This gateway converts between BACnet™ IP or Modbus TCP protocol, and RS-485 LGAP (LG Aircon protocol) allowing third party control and monitoring of the LG A/C system, or LonWorks™ gateways. See controls specification for points list.
- .13 Wi-Fi Communication:
- .1 The outdoor unit microprocessor shall be capable of being monitored via an optional Wi-Fi wireless communications dongle or embedded Wi-Fi transmitter. Wi-Fi shall allow service or maintenance personnel access to the complete operating system, via LGMV mobile, without need of tools other than smart phone or tablet. Active live system review, collection of all system data for a field determined duration presented in a .csv file format or collection of all operating conditions, including all indoor units, valves, sensors, compressor speeds, refrigerant pressures, etc., by snapshot of conditions and placing that snapshot into a power point slide to be reviewed at another time. Systems that require computers, hard wire only connection or other devices to collect, review or record operating conditions shall not be allowed.

- .14 Indoor Unit Connectivity:
  - .1 The system shall be designed to accept connection up to 64 indoor units of various configuration and capacity, depending on the capacity of the system.
- .15 Power and Communication Interruption:
  - .1 The system shall be capable of performing continuous operation when an individual or several indoor units are being serviced; communication wire cut or power to indoor unit is disconnected from power for a minimum of a 24 hour period. Systems that alarm and/or shut down because of a lack of power to any number of indoor units shall not be acceptable.
- .16 Connection Ratios:
  - .1 The maximum allowable system combination ratio for all VRF systems shall be 130% and the minimum combination ratio shall be 50%.
- .17 Comfort Cooling Mode:
  - .1 Comfort cooling shall be initiated via a field setting at the outdoor unit during commissioning or anytime thereafter. Comfort cooling shall allow user to select all or some of the indoor units of a system to automatically modify each of the indoor unit's superheat target set point based on the impending total cooling load of on the indoor unit, the rate of change of the zone temperature relative to set point and optionally, if specified, the rate of change of the zone humidity level.
- .18 The outdoor unit shall be provided with a factory installed fusible plug or rupture disc. The fusible plug connection shall be threaded for easy connection with a field provided vent pipe to safely discharge the system's refrigerant charge away from the outdoor unit if a building fire causes an extreme pressure condition in the outdoor unit refrigerant circuit employ for safety a threaded fusible plug.
- .19 Refrigerant Flow Control
  - .1 An active refrigerant -in-circulation control system consisting of a refrigerant storage container, interconnecting refrigerant piping control valves, pressure transducers, microprocessor control, and software to continuously monitor necessary refrigeration cycle operating parameters to maintain stable cycle operation between minus (-)22°F and 122°F ambient conditions. The refrigerant system operating conditions shall be checked by the algorithm at three minute intervals and if needed automatically and dynamically remove and store refrigerant to the storage tank or inject refrigerant from the tank into the refrigerant circuit.
    - .1 The algorithm shall adjust refrigerant charge automatically:
      - .1 As the outdoor air temperature changes;
      - .2 System mode of operation changes;



- .3 The path of refrigerant flow through the outdoor coil is modified;
    - .4 The system's target suction and head pressure control values are adjusted.
  - .2 Subcooler: The VRF outdoor unit shall include a factory provided and mounted sub-cooler assembly consisting of a shell and tube-type sub-cooling heat exchanger and EEV providing refrigerant sub-cooling modulation control by fuzzy logic of EEV and by mode of operation to provide capacity and efficiency as required. Braze plate heat exchangers shall not be allowed for this function.
  - .3 Advanced Smart Load Control: The air source unit shall be provided with Smart Load Control (SLC) enhanced energy saving algorithm that reduces compressor lift during off-peak operation to further reduce system energy consumption when weather and load conditions permit.
    - .1 The SLC algorithm shall be monitoring in real time, the rate of change of the outdoor ambient air temperature, either the outdoor ambient air relative humidity or the indoor air relative humidity [field selectable], and the rate of change of the building load.
    - .2 The SLC algorithm shall foresee pending changes in the building load, outdoor temperature and humidity (or indoor humidity) and proactively reset head and/or suction pressure targets in anticipation of the reduction/increase in building load.
    - .3 The SLC algorithm shall provide no fewer than three (3) field selection options to maximize the control of the VRF system operation during morning warm-up or cool-down following night-setback reset. The selection shall be set by the commissioning agent (or at any other time thereafter).  
Selectable algorithm choices include:
      - .1 Maximize energy savings
      - .2 Balance the rate of temperature change with energy consumed.
      - .3 Quickly cool/heat the building.
- .20 Refrigerant Volume Management
  - .1 Active Refrigerant Charge
    - .1 The VRF system shall be able to operate at any and all published conditions year round in cooling or heating mode without the need of adding or removing refrigerant from the system.
    - .2 The air source unit shall be provided with an isolated vessel, interconnecting piping, valves and sensors to store refrigerant and actively pass refrigerant to (or from) the refrigerant circuit in real time as necessary to maintain stable refrigeration cycle operation.

- .3 The air source unit microprocessor shall be provided with an algorithm that monitors the VRF system head pressure, suction pressure, subcooling, superheat, compressor speed, high and low side temperatures and the load on the system at three minute intervals and if needed, automatically and dynamically remove and store refrigerant to the storage tank or inject refrigerant from the tank into the refrigerant circuit
- .21 VRF Systems with Onboard Alternate Operating Mode Selection Capability
  - .1 All VRF systems equipped with field selectable Alternate Operating Modes via DIP Switch or other means, for example but not limited to, High Heat, High Ambient Cooling, High Sensible, or Enhanced Efficiency selections. Performance using the proposed field selected Alternate Operating Mode shall be tested using AHRI Standard 1230 and published in the AHRI Directory.
  - .2 Acceptable Alternate Operating Modes must ship with all models of the VRF product offering and must be factory embedded. Custom factory or field modifications to factory provided algorithms created to meet scheduled requirements are not acceptable.
  - .3 Provide a copy of instructions required to set the Alternate Operation Mode with the initial submittal.
  - .4 For systems that provide field selectable Alternate Operating Modes, ALL technical data provided in the submittal data sheets showing product rated condition performance data, must also provide separate data sheets that show product performance data at each of the field selectable Alternate Operating Modes available. Capacity, power input, and acoustic performance data for each mode offered shall be reported separately. Mixing of ODU, IDU, or VRF system performance capability operating in one mode with for example the power consumption, sound power rating, or electrical requirements of the same system operating in another mode is not acceptable.
- .5 Field Supplied Refrigerant Piping Design Parameters
  - .1 The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively without the requirement of field installed subcooler or other forms of performance enhancing booster devices.
  - .2 The outdoor unit shall be capable of operating with up to 3280 equivalent length feet of interconnecting liquid line refrigerant pipe in the network.
  - .3 The outdoor unit shall be capable of operating with up to 656 actual feet or 738 equivalent length feet of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.
  - .4 The piping system shall be designed with pipe expansion and contraction possibilities in mind. Required expansion devices shall be field designed, supplied and installed based on proper evaluation of the proposed piping design. In addition to these requirements, the piping system installation must conform to the VRF equipment manufacturer's published guidelines.

- .5 The installation of pipe hangers, supports, insulation, and in general the methods chosen to attach the pipe system to the structure must allow for expansion and contraction of the piping system and shall not interfere with that movement.
- .6 The elevation difference between indoor units on heat pump systems shall be 131 feet.
- .7 The elevation differences for heat recovery systems shall be:
  - .1 Heat recovery unit to connected indoor unit shall be 49 feet
  - .2 Heat recovery unit to heat recovery unit shall be 98 feet
  - .3 Indoor unit to indoor unit connected to same heat recovery unit shall be 49 feet
  - .4 Indoor unit to indoor unit connected to separate parallel piped heat recovery units shall be 131 feet.
- .8 The acceptable elevation difference between two series connected heat recovery units shall be 16 feet.
- .6 Defrost Operations
  - .1 The outdoor unit(s) shall be provided with a minimum of 4 independent field adjustable defrost cycle algorithms to maximize the effectiveness of the defrost cycle to the local weather conditions. Intelligent Defrost shall melt accumulated frost, snow and ice from the outdoor unit heat exchanger. The defrost cycle length and sequence shall be based on outdoor ambient temperatures, outdoor unit heat exchanger temperature, and various differential pressure variables. Intelligent Heating Mode, when outdoor unit humidistat is engaged, shall extend the normal heating sequences by adjusting the outdoor unit coil target temperature to be above the ambient dew point temperature delaying the need for defrost operations, so long as heating demand is being met
  - .2 Smart Heating: This feature shall be capable of eliminating several defrost actions per day based on outdoor air temperature and humidity conditions. Smart heating shall extend the heating operation cycle by delaying the frost formation on the outdoor coil by adjusting the surface temperature to keep it above the current outdoor ambient dew point. The algorithm shall delay while maintaining indoor space temperature
  - .3 Defrost Mode Selection: The outdoor unit shall be provided with a minimum of three field selectable defrost operation modes: Normal, Fast, or Forced.
    - .1 Normal Defrost: Operation intended for use in areas of the country that experience adverse winter weather with periods of heavy winter precipitation and extremely low temperatures. This strategy shall maximize the systems heating performance and maintain operational efficiency. When the ambient temperature is either: a) above 32°F or b) below 32°F with the humidity level below 60% RH, Intelligent Defrost shall continue heating regardless of ice build-up on the coil until the quality of the heated air (i.e. discharge air temperature) decreases. At temperatures below 4°F, a defrost cycle shall occur every two hours to optimize system heating efficiency.

- .2 Fast Defrost: Operation intended for use in areas of the country with mild winter temperatures and light to moderate humidity levels. The strategy minimizes defrost cycle frequency allowing frozen precipitation to build longer in between cycles. Minimum time between defrost cycles shall be 20 minutes. Intelligent Defrost shall choose between split coil/frame and full system methods based on current weather conditions to minimize energy consumption and maximize heating cycle time.
- .3 Forced Defrost: Operation shall be available for the service provider to test defrost operations at any weather condition and to manually clear frozen water from the outdoor coil surfaces.
- .4 Defrost Method Selection: The outdoor unit shall be provided with two field selectable defrost operation methods: Split Coil/Frame and Full System. Split Coil/Frame option provides continuous heating of the occupied space during defrost operation.
  - .1 Split Coil/Frame method shall be available when Normal Defrost mode is selected. Split Coil method shall be available on all Heat Pump and Heat recovery single-frame VRF systems. Split Frame defrost shall be available on all Heat Pump and Heat recovery multi-frame outdoor units.
  - .2 Split Coil method shall remove ice from the bottom half of the outdoor unit coil first for a maximum time of six minutes, then the top half for a maximum of six minutes. Next the bottom coil shall be heated again for an additional three minutes to remove any frozen water that may have dripped onto the lower coil during the top coil defrost operation.
  - .3 When Split Coil/Frame method is selected, a Full System defrost shall occur every 1-9 (field selectable) defrost cycles to assure 100% of the frozen precipitation has been removed to maintain efficient performance.
  - .4 Full System method shall be available as a field selectable option. All outdoor units located in areas of the country where large volumes of frozen precipitation are common, the commissioning agent shall be able to select the Full System only defrost method.
- .5 Indoor Unit Fan Operation During Defrost
  - .1 During partial defrost operation indoor units operating in cooling or dry mode shall continue normal operation.
  - .2 During partial defrost operation, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the defrost cycle.
  - .3 During full system defrost operation indoor unit fans will cycle off and remain off during the remainder of the defrost cycle.

.7 Oil Management

- .1 The system shall utilize a high pressure oil return system to ensure a consistent film of oil on all moving compressor parts at all points of operation. Oil is returned to compressor through a separate high pressure oil injection pipe directly into the oil sump. Oil returned to the compressor via the suction port of the compressor shall not be allowed.
- .2 Each compressor shall be provided with a high efficiency independent centrifugal cyclone type oil separator, designed to extract oil from the oil/refrigerant gas stream leaving the compressor.
- .3 The system shall have an oil level sensor in the compressor to provide direct oil level sensing data to the main controller. The sensor shall provide data to main outdoor unit PCB to start oil return mode and balance oil levels between multiple compressors.
- .4 The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values as determined by the microprocessor. The system shall display an error if the oil sensor signals low oil level for a period of 130 minutes or longer.
- .5 A default oil return algorithm shall automatically initiate the oil return mode if the system detects a failure of the oil sump sensor. A fault code shall be reported by the system.
- .6 Timed oil return operations or systems that do not directly monitor compressor oil level shall not be permitted.
- .7 Indoor Unit Fan Operation during Oil Return Cycle
  - .1 During oil return cycle indoor units operating in cooling or dry mode shall continue normal operation.
  - .2 During oil return, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the oil return cycle.
  - .3 During oil return cycle indoor unit fans will cycle off and remain off during oil return cycle while operating in all modes.

.8 Fan and Motor Assembly

- .1 6 ton frames shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge
- .2 8 to 20 ton frames shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
- .3 The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material and incorporate biomimetic technology to enhance fan performance and reduce fan generated noise.
- .4 The fan(s) motor shall be equipped with permanently lubricated bearings.
- .5 The fan motor shall be variable speed with an operating speed range of 0-1150 RPM cooling mode and 0-1150 RPM heating mode.
- .6 The fan shall have a guard to help prevent contact with moving parts.

- .7 The cabinet shall have option to redirect the discharge air direction from vertical to horizontal with the addition of optional factory provided air guides.
  - .8 The fan controller shall have a DIP switch setting to raise external static pressure of the fan up to 0.32 inch of W.C. to accommodate ducted installations.
  - .9 The fan control shall have a function setting to remove excess snow automatically.
  - .10 The fan control shall have a function setting to remove access dust and light debris from the outdoor unit and coil.
- .9 Cabinet
- .1 Outdoor unit cabinet shall be made of 20 gauge galvanized steel with a weather and corrosion resistant enamel finish. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray surface scratch test (SST) procedure for a minimum of 1000 hours.
  - .2 Cabinet weights and foot prints shall vary between 430 lbs., 7.61 sq. ft. (1.27 sq. ft. per ton), for 6 ton cabinet to 666 lbs., 10.14 sq. ft. (.51 sq. ft. per ton), for 20 ton cabinet for single cabinet configurations. The front panels of the outdoor units shall be removable type for access to internal components.
  - .3 A smaller service access panel, not larger than 7" x 7" and secured by a maximum of (2) screws, shall be provided to access the following:
    - .1 Service tool connection
    - .2 DIP switches
    - .3 Auto addressing
    - .4 Error codes
    - .5 Main microprocessor
    - .6 Inverter PCB
  - .4 The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front, right side, or through the bottom of the unit.
  - .5 The cabinet shall have a factory installed coil guard.
- .10 Outdoor Unit Coil
- .1 Outdoor unit coil shall be designed, built and provided by the VRF outdoor unit manufacturer
  - .2 The outdoor unit coil for each cabinet shall have lanced aluminum fins with a maximum fin spacing of no more than 17 Fins per Inch (FPI). All the outdoor unit coils shall be a 2 or 3 rows consisting of staggered tubes for efficient air flow across the heat exchanger
  - .3 Outdoor unit coil shall be comprised of aluminum fins mechanically bonded to copper tubing with inner surfaces having a riffling treatment to expand the total surface of the tube interior.

- .4 The aluminum fin heat transfer surfaces shall have factory applied corrosion resistant Black Fin coating. The copper tubes shall have inner riffling to expand the total surface of the tube interior.
  - .1 ISO 21207 Salt Spray Test Method B – 1500 hours
  - .2 ASTM B-117 Acid Salt Test – 900 hours
  - .3 The Black Fin coating shall be certified by Underwriters Laboratories and per ISO 21207. The above conditions shall establish the minimum allowable performance which all alternates must comply.
- .5 Variable Path Heat Exchanger: System shall have a variable flow and path outdoor heat exchanger function to vary the refrigerant flow and volume and path. Control of the variable path circuits shall be based on system operating mode and operating conditions as targeted to manage the coil heat transfer capacity and efficiency. The variable path heat exchanger technology shall be provided to maintain stable refrigeration cycle operation during mild weather conditions and maintain a robust hot vapor temperature system head pressure that delivers “gas-furnace leaving air temperature” from the indoor unit at sub-zero outdoor air temperature down to minus (-) 22°F. The outdoor unit coil, all indoor units and pipe network shall be field tested to a minimum pressure of 550 psig.
- .11 Compressor(s)
  - .1 Compressor shall be designed and assembled by the VRF manufacturer specifically for use in the air source VRF product line. Third party manufactured, branded, or designed to the VRF system’s OEM specifications by a third party manufacturer shall not be acceptable.
  - .2 Compressor shall be a hermetic, high-side shell (HSS), commercial grade, compliant scroll direct-drive design
    - .1 Compressor Design: The compressor design shall be of the high pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be at the same high pressure and high temperature. The motor shall be cooled by high pressure gas at temperatures above saturation conditions and minimize the mixing of refrigerant liquid with oil in the sump. The system shall employ a high pressure oil return method returning recovered oil from the oil separator directly into the oil sump of the compressor; oil shall not be allowed to return via the suction line. Bearing surfaces are continually coated with oil. The compressor shall employ an Aero-bearing constructed with high lubricity materials increasing operation time in case of low sump oil level. Compressor shall have a nominal operating range from 12Hz to 150 Hz.
  - .3 The fixed and oscillating compressor scroll components shall be made of high grade (GC25) or denser steel material. All scrolls shall be heat treated and tempered.

- .4 The oscillating scroll shall be finely machined and polished. PVE refrigerant oil shall be used as the sole liquid used to maintain a seal between the high and low sides of the compression chamber. Compressors that requires the use of any type of mechanical or wearable sealant material between the moving surfaces of the compression chamber is NOT ACCEPTABLE.
- .5 Vapor Injection: System shall have a medium pressure gas vapor injection function employed in the heating and cooling modes to increase system capacity when the outdoor ambient temperatures are low and lower compressor lift when temperatures are high. The compressor vapor injection flow amount shall be controlled by the vapor injection sub-cooling algorithm reset by discharge gas temperatures of the compressor.
- .6 Bearing surfaces shall be coated with Teflon® equal. Bearings shall be lubricated using a constant flow of PVE refrigerant oil to the bearing surfaces The film of oil separating the crankshaft journals and bearing surfaces shall be consistent at all times the crankshaft is in motion and shall be maintained irrelevant of crankshaft rotational speed.
- .7 An internal, integrated, mechanically driven gear pump shall draw oil from the compressor sump reservoir, pressurize the oil and inject the oil directly to the crankshaft journals maintaining a consistent film of oil between all moving parts. Auxiliary, indirect, or electronically driven pumps are not acceptable.
- .8 The viscosity property of the PVE oil in the compressor sump shall be maintained irrelevant or compressor operation and the surrounding ambient temperature.
  - .1 The compressor shall be equipped with an external thermally protected electric crankcase heater that is automatically activated only when the ambient temperature is below freezing and the compressor is not running to maintain the temperature of the oil in the sump above the refrigerant boiling point.
  - .2 During stable operation, irrelevant of ambient air temperature outside the water source unit, the temperature of refrigerant vapor in contact with the surface of the oil in the compressor sump shall be maintained above 140°F to prevent foaming and to eliminate refrigerant from mixing with the oil degrading the viscosity of the oil in the sump.
  - .3 Low side shell (LSS) type compressors that use suction vapor to cool the compressor motor shall not be acceptable.
- .9 The compressor motor shall be designed to operate at high temperatures.
  - .1 The motor winding insulation shall be designed to operate continuously at a minimum temperature of 180°F without deterioration.
  - .2 The motor cooling system shall be designed to maintain acceptable operational temperature at all times and in all conditions using high pressure, hot refrigerant vapor as motor coolant.
  - .3 Low side shell (LSS) and compressors that use low pressure, low temperature refrigerant gas to cool the motor are not acceptable.



- .10 Inverter Compressor Controller(s)
  - .1 Each compressor shall be equipped with a dedicated inverter compressor drive. The control of multiple compressors using a single drive is not acceptable.
  - .2 The inverter drive shall vary the speed of the compressor crankshaft between zero (0) Hz and 140 Hz.
  - .3 The inverter driver controller shall be matched with the physical properties of the compressor. The drive shall be manufactured by the VRF air source unit manufacturer. The inverter drive and matching compressor shall have been thoroughly tested as a matched pair. The inverter drive shall be programmed to avoid operating the compressor at any speed that results in harmonic vibration, nuisance noise, or mechanical damage to either the driver or the compressor with power provided that is within the tolerance specification.
  - .4 The compressor inverter drive assembly and software must be designed, manufactured, and supplied by the VRF product manufacturer. Third party branded inverter driver hardware and/or driver software or inverter driver hardware and/or software provided by a third party manufacturer to meet OEM specifications of the VRF water source manufacturer will not be acceptable.
  - .5 All inverter drive hardware or software manufactured in, is a product of, or sourced from China, or using a broker or third party provider as an intermediary that obtains the product from CHINA shall not be acceptable.
- .11 Compressor(s)
  - .1 Each 6, 8, and 10 ton frame shall be equipped with a single hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressor.
  - .2 12, 14, 16, 18 and 20 ton frames shall be equipped with dual hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressors.
  - .3 Each inverter driven, HSS scroll compressor shall be capable of operating from 12 Hz up to 150 Hz in any and all modes (cooling, heating or simultaneous modes).
  - .4 The compressor shall be designed for a separate port for oil to be directly returned to the compressor oil sump.
  - .5 The compressor bearing(s) shall have Teflon™ coating and shall be an aero type design using High lubricity materials.
  - .6 The compressor(s) shall be protected with:
    - .1 High Pressure switch
    - .2 Over-current /under current protection
    - .3 Oil sump sensor
    - .4 Phase failure
    - .5 Phase reversal

- .7 Compressor shall be capable of receiving injection of medium pressure gas at a point in the compression cycle where such injection shall allow a greater mass flow of refrigerant at lower outdoor ambient and achieving a higher heating capability. The VRF outdoor unit shall have published performance data for heating mode operation down to -22°F on both heat pump and heat recovery systems.
  - .8 Standard, non-inverter driven compressors shall not be permitted nor shall a compressor without vapor injection or direct sump oil return capabilities.
- .12 Operational Sound Levels
  - .1 The compressor(s) shall be mounted on rubber isolation grommets. Compressor shall ship with removable clamps that secure the compressor in place while transported. The installing contractor shall remove and discard (or optionally adjust the clamps to allow the isolator to properly function) the clamps prior to commissioning the water source unit.
  - .2 Each single frame outdoor unit shall be rated with an operational sound pressure level not to exceed as listed on below chart when tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available. Such documentation shall be presented in all submittals, manufactures who elect to rate their equipment at other than tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available and the highest field selectable conditions shall not be allowed.
  - .3 A field setting shall be available to program the outdoor unit to reduce sound levels at night, when desired, to a selectable level while still able to meet building load requirement. This mode is available in both cooling and heating modes.
- .13 Sensors
  - .1 Each outdoor unit module shall have:
    - .1 Suction temperature sensor
    - .2 Discharge temperature sensor
    - .3 Oil level sensor
    - .4 High Pressure sensor
    - .5 Low Pressure sensor
    - .6 Outdoor temperature sensor
    - .7 Outdoor humidity sensor
    - .8 Outdoor unit heat exchanger temperature sensors
- .14 Wind Load Installations for Outdoor Units
  - .1 Provide Florida wind Load Installation Drawings that meet the requirements of the 2017 Florida Building Code, 6th Edition and ASCE Standard 7-2010 with submittal

.15 Seismic Installations

- .1 Provide with submittal: 1) OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. 2) Equipment installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install units on a flat surface level within 1/8 inch. Provide intermediate supports as recommended by the equipment manufacturer.
- .2 For ceiling hung installations, provide a reinforced steel framework to adequately support all unit sections.
- .3 Provide certified wiring schematics to the Electrical Division for associated equipment and controls.
- .4 Provide all necessary control wiring as recommended by the manufacturer.
- .5 High/low pressure gas line, liquid and suction lines must be individually insulated between the outdoor and indoor units.
- .6 Provide testing of all drain pans and condensate pumps to ensure positive drainage. Repair same as required. Provided written confirmation all condensate drain pans are draining to manufacturer's requirements.
- .7 Contact distributor or manufacturer's representative to review and confirm piping layout and lengths prior to installation.
- .8 Use refrigeration best practice to allow pipes to expand and contract freely. Review manufacturer installation instructions to ensure expansion joints are properly designed.
- .9 Pressure test ALL systems to 550 PSI after system was vacuumed and held to below 500 microns for at least one hour. Review manufacturer installation instructions for proper pressure test procedures.

**3.2 REFRIGERATION DETECTION SYSTEM INSTALLATION**

- .1 Refrigerant Leak Detection System Installation
  - .1 This contractor shall provide all wiring between leak detection systems installed within the provided equipment and system components in the spaces served and ductwork system.
  - .2 Specifically, the following shall occur for each independent system on registration of a refrigerant leak:
    - .1 Open all zone dampers in the affected system.
    - .2 Disable all electric reheat coils within the affected system.
    - .3 Activate field installed safety shut off valves within the affected refrigeration system.

- .4 Energize all fans within the affected ductwork system.
    - .5 Activate and refrigerant leak system specific ventilation systems.
    - .6 De-energize any other potential sources of ignition within the affected system.
  - .3 All interlocks between field installed detection systems and associated safety system components shall be tested and verified to operate as per the requirements of CSA B52.
  - .4 Location of all refrigerant release safety valves shall be marked on ceilings and on as-built drawings.
- .2 Verification and Commissioning of Refrigeration Leak Detection System Operation
  - .1 The commissioning process shall include the verification of the refrigeration leak detection system and safety shut off valves in accordance with the requirements of CSA B52.
  - .2 All interlocks between leak detection systems installed and system components, as well as interlocks between field installed detection systems and associated safety system components shall be tested and verified to operate as per the requirements of CSA B52. Specifically, the following shall occur for each independent system on registration of a refrigerant leak:
    - .1 Open all zone dampers in the affected system.
    - .2 Disable all electric reheat coils within the affected system.
    - .3 Activate field installed safety shut off valves within the affected refrigeration system.
    - .4 Energize all fans within the affected ductwork system.
    - .5 Activate and refrigerant leak system specific ventilation systems.
    - .6 De-energize any other potential sources of ignition within the affected system.
    - .7 Refrigerant leak safety valves shall close.

### **3.3 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
  - .2 Contractor hereby warrants refrigeration compressors for five (5) years.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CAN/CGSB-51.40, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
- .3 EPS 1/RA/2, Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .4 C.1 CSA B52-2023, Mechanical Refrigeration Code
- .5 C.2 CAN/CSA-C22.2 No 60335 Safety of Household and similar electrical appliances – Heat Pumps, Air-conditioners and dehumidifiers

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with general conditions.
- .2 Indicate major components and accessories including sound power levels of units.
- .3 Type of refrigerant used.

**1.3 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into manual specified in general conditions.

**Part 2 Products**

**2.1 GENERAL**

- .1 System type:
  - .1 Air flow arrangement: vertical upflow.
  - .2 Cooling: direct expansion.
  - .3 Condensing: air cooled.

**2.2 VERTICAL FAN COIL UNIT**

- .1 Indoor, direct-expansion fan coil, complete with cooling coil, fan, fan motor, piping connectors, electrical controls.
- .2 Fan shall be multi-speed direct-drive blower type with bottom intake and top discharge.
- .3 DX coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap and auxiliary drip pan under coil header.
- .4 Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 3-speed.

- .5 Controls shall consist of a wall mounted auto changeover thermostat with an on-auto switch.
- .6 Filter track with factory-supplied disposable filters.
- .7 Capacity: As indicated.
- .8 Accessories: Remote economizer box and controls.
- .9 Acceptable materials:
  - .1 LG
  - .2 Carrier.
  - .3 Lennox.
  - .4 Daikin

## **2.3 OUTDOOR CONDENSING UNITS**

- .1 General:

Factory-assembled, single piece, air-cooled condensing unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge (R-22), and special features required prior to field start-up. Unit shall be rated in accordance with ARI Standard and be CSA approved.
- .2 Unit Cabinet:
  - .1 Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a prepainted baked enamel finish.
  - .2 A heavy gage roll-formed perimeter base rail with forklift slots and lifting holes shall be provided to facilitate rigging.
- .3 Fans:
  - .1 Condenser fans shall be direct driven, propeller-type, discharging air vertically upward.
  - .2 Fan blades shall be balanced.
  - .3 Condenser fan discharge openings shall be equipped with PVC coated steel wire safety guards.
  - .4 Condenser fan and motor shaft shall be corrosion resistant.
- .4 Compressor:
  - .1 Compressor shall be of the hermetic reciprocating type or semi-hermetic reciprocating type.
  - .2 Compressor shall be mounted on vibration isolators.
  - .3 Compressors shall include overload protection.
- .5 Condenser Coil:
  - .1 Condenser coil shall be air-cooled and circuited for integral subcooler.
  - .2 Coil shall be constructed of aluminum fins (copper fins optional) mechanically bonded to internally grooved seamless copper tubes which are then cleaned, dehydrated, and sealed.

- .6 Controls and Safeties:
  - .1 Minimum control functions shall include:
    - .1 Control wire terminal blocks.
    - .2 Five-minute recycle protection to prevent compressor short-cycling.
    - .3 Compressor lockout on auto-reset safety until reset from thermostat.
  - .2 Minimum Safety devices which are equipped with automatic reset (after resetting first at thermostat), shall include:
    - .1 High discharge pressure cutout.
    - .2 Loss-of-charge cutout.
- .7 Electrical Requirements:
  - .1 Voltage and capacity as noted.
  - .2 Unit electrical power shall be single-point connection.
  - .3 Unit control circuit shall contain a 24-V transformer for unit control.
- .8 Capacity: As noted.
- .9 Provide the following:
  - .1 Hail Guard Package.
  - .2 Winter Start Package.
  - .3 Acceptable materials:
    - .1 Carrier 38CKC
    - .2 Trane
    - .3 Lennox

## 2.4 REFRIGERANT

- .1 Refrigerant shall be A1 or A2L Classified.
- .2 Refrigerant holding charge shall be applied at factory.
- .3 Refrigeration circuit components shall include liquid line service valve, suction line service valve, liquid filter drier, a full charge of compressor oil, a holding charge of refrigerant and leak mitigation solenoid valves.
- .4 The system shall be equipped with minimum **2** compressors and independent refrigeration circuits to limit the volume of refrigerant that may be released in the event of a leak.
- .5 The maximum charge allowed per circuit is **5** lbs. Provide additional compressors/circuits if required to keep charge below this value.
- .6 The maximum allowed releasable refrigerant volume is **5** lbs. Provide leak detection and solenoid valves to limit release volume from each circuit.
- .7 Refrigerant coils with multiple compressors shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions. (split face coils are not acceptable). Provision for use of thermal expansion valves must be included for variable air volume applications.

- .8 Provide refrigerant leak detectors for installation in served space. Detector shall close refrigeration leak safety valve to limit charge released into space/atmosphere.
- .9 The Refrigerant detection system shall meet the requirements of CSA B52 and have the following functionality:
  - .1 Utilize a set point, nonadjustable in the field, to generate a digital output signal to initiate mitigation actions to both internal safeties and external components in the ductwork (dampers, electric coils etc.). Signal shall be generated in not more than 30 seconds from sensor exposure to refrigerant concentration of 25% LFL (+0%, -1%)
  - .2 Field calibration of the system is not allowed.
  - .3 Be capable of detecting the refrigerant used in the system.
  - .4 Have self diagnostics
  - .5 Activate refrigerant safety shut off valves in the event of a leak being detected.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 The installing contractor shall provide and install between the indoor and outdoor unit the interconnecting refrigerant tubing of the size recommended by the unit manufacturer. The installing contractor shall evacuate the indoor coil and interconnection tubing and charge the system in accordance with manufacturer's recommendations.
- .2 Install as indicated, to manufacturers' recommendations.
- .3 Manufacturer to certify installation.
- .4 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

#### **3.2 EQUIPMENT PREPARATION AND START-UP**

- .1 Provide services of manufacturer's authorized factory trained mechanic to set and adjust equipment for operation as specified.
- .2 Provide results in operation and maintenance manuals

#### **3.3 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .1 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.



- .2      Warranty Duration:
  - .1          Two (2) year warranty period applies.
  - .2          Contractor hereby warrants refrigeration compressors for five (5) years.
- .3      Warranty Coverage:
  - .1          Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
  - .1 Equipment, capacity and piping connections.
  - .2 Dimensions, internal and external construction details, recommended method of installation with proposed [structural steel] support, sizes and location of mounting bolt holes.

**1.2 MAINTENANCE**

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

**Part 2 Products**

**2.1 HORIZONTAL UNIT HEATERS**

- .1 Casing: 1.6 mm (16 gauge) thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.
- .2 Coils: seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing. Hydrostatically test to 1 MPa (145 psi).
- .3 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.
- .4 Motor: speed as indicated continuous duty, built-in overload protection, and resilient motor supports.
- .5 Air outlet: two-way adjustable louvres.
- .6 Capacity: as indicated.
- .7 Control room thermostat: electric, [line] voltage, locking cover, set point locking device, concealed adjustment, plastic cover.
- .8 Acceptable material
  - .1 Reznor
  - .2 Engineered Air

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide double swing pipe joints as indicated.

- .3 Check final location with [Consultant] if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow [Consultant's] directive.
- .4 Hot water units: for each unit, install [gate] valve on inlet and balancing valve on outlet of each unit. Install drain valve at low point. Install manual air vent at high point.
- .5 Steam units: for each unit, install gate valve on inlet, steam trap assembly as indicated on outlet.
- .6 Clean finned tubes and comb straight.
- .7 Provide supplementary suspension steel as required.
- .8 Thermostats on outside walls: mount on insulated backplates.
- .9 Before acceptance, set discharge patterns and fan speeds to suit requirements.

### **3.2 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED WORK**

- .1 Ductwork Section.
- .2 Installation of duct accessories and heaters Section.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Include:
  - .1 Element support details.
  - .2 kW rating, voltage, phase.
  - .3 Physical size.
  - .4 Unit support.
  - .5 Performance limitations.
  - .6 Clearance from combustible material.
  - .7 Internal components wiring diagrams.
  - .8 Minimum operating air flow.
  - .9 Pressure drop and minimum air flow.

**1.3 REFERENCES**

- .1 C.1 CSA B52-2023, Mechanical Refrigeration Code
- .2 C.2 CAN/CSA-C22.2 No 60335 Safety of Household and similar electrical appliances – Heat Pumps, Air-conditioners and dehumidifiers

**Part 2 Products**

**2.1 DUCT HEATERS**

- .1 Duct heaters: flange type
- .2 Elements:
  - .1 Helical coils of nickel chrome alloy resistance wire.
- .3 Staging:
  - .1 Staged heaters: balanced line current at each stage.
  - .2 Each stage: uniform face distribution.
- .4 Controls:
  - .1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.

- .2 Controls mounted in a CSA enclosure and to include:
  - .1 Contactors.
  - .2 Control transformers.
  - .3 Controller.
- .3 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
- .4 Controls must accept a low voltage input signal from a refrigerant leak detection system that de energizes the unit. Input must automatically reset.
- .5 Acceptable materials:
  - .1 P.M. Wright
  - .2 Chromalox
  - .3 Thermolec
  - .4 Hazloc (EXPL)

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install as per manufacturers requirements.
- .2 Power connection will be by Electrical Division. All control wiring shall be by this contractor.
- .3 Wire refrigerant leak detection system to coil.

#### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Electrical general requirements section.

#### **3.3 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.

**1.2 CLOSEOUT SUBMITTALS**

- .1 Record on drawings, layout of infloor heating piping in poured concrete. Indicate depth of piping where applicable.

**1.3 REFERENCES**

- .1 PPI.PE3408 with an HDB of 1000 psi (6,895 kPa) for water at 140°F (60°C).
- .2 Canadian Standards Association (CSA) B137.1 as PE3408 with a HDB of 1600 psi (11,031 kPa) for potable water.
- .3 Canadian General Standards Board (CGSB) 41-GP-25A – “Pipe, Polyethylene for the transport of Liquids”.
- .4 National Sanitation Foundation (NSF) Standards 14 and 61 for potable water pipe and fittings.

**Part 2 Products**

**2.1 GENERAL**

- .1 Furnish a Radiant Floor Heating System as indicated complete with piping, distribution manifolds, REHAU “Everloc” type embeddable tubing couplings (if required), Floor Temperature Controller, prepiped hydronic manifold cabinet complete with 3-Way mixing valve, pressure and temperature gauges, system pump as specified elsewhere suitable from 120/1/60. Include all floor heat installation specialties as required for the complete system. Equipment, detailed pipe layout shop drawings, technical support and any field contractor supervision shall be provided by the manufacturer. All tubing shall be high density cross-linked polyethylene complete with a co extruded oxygen diffusion barrier.
- .2 Complete a system pressure test prior to installing thermal mass with either air or water (take necessary precautions to prevent water from freezing). Complete all inspection and test reports as supplied by the manufacturer of the system.
- .3 The high density polyethylene pipe is manufactured exclusively from material listed by the Plastic Pipe Institute as a PE3408 resin with a hydrostatic design basis (HDB) of 1600 psi (11,031 kPa) for water at 73.4°F (23°C). It complies with ASTM D1248 as a Type III, Class C, Category 5, Grade P34 and with ASTM D3350 as a 345434C cell class material.
- .4 Pipe embedded in concrete shall be rated at 180°F maximum working temperature and up to 100 psi working pressure in accordance with ASTM standard F876 and F877.

- .5 The minimum bend radius for cold bending of the pipe shall not be less than eight (8) times the outside diameter. Bends with a radius less than stated will require the use of a bend support by the pipe manufacturer.

## **2.2 FITTINGS**

- .1 Tubing fittings shall be manufactured of dezincification resistant brass. These fittings must be supplied by the pipe manufacturer. The pipe fitting consists of a barbed insert, a serrated compression ring, and a nut, and be capable of connecting to the manifold or a pipe splice.

## **2.3 MANIFOLDS**

- .1 Tubing, distribution manifolds with venting/air purge valve, manifold to tubing fittings.
- .2 Manifolds shall be of cast bronze construction and shall have integral loop balancing, and loop control valves. Return manifold shall be able to vent air from the system, and shall be provided with support (mounting) brackets. Manifolds shall be isolated from supply and return piping with valves that are suitable for isolation and balancing. Provide visible flow meter for each manifold loop.
- .3 Integral circulation pumps where required & noted on drawings.
- .4 Integral 4-way mixing valve and/or 2-way zone control valves where indicated.
- .5 Install manifolds and all accessories in wall mounted cabinet as indicated.

## **2.4 ACCESSORIES**

- .1 Galvanized steel prepunched strapping to hold cables in place when embedded in concrete.
- .2 Steel wire mesh: 2.6 mm (12 gauge) diameter on 150 mm (6") centres for use with cables embedded in concrete.

## **2.5 CONTROLS**

- .1 Zone valves, and telestats to open upon call for heat, thermostats and slab sensors to have anticipator specifically designed for radiant floor heating systems. Coordinate controlling voltage with BAS contractor.
- .2 Thermostat: remote fully recessed concealed type, provided by infloor heating manufacturer.
- .3 Computerized integrated controller to control valves and pumps from the slab sensors and space thermostats.
- .4 Alarms upon failure.
- .5 BACnet interface controller for connect to BAS controls.

## **2.6 ACCEPTABLE MATERIALS**

### **.1 Acceptable Materials:**

- .1 Wirsbo
- .2 Ipex
- .3 Heat Link
- .4 Rehau

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install cables in accordance with manufacturer's instructions.
- .2 Secure cable to anchoring devices and confine cable within 150 mm (6") minimum from edge of slab.
- .3 Protect heating cables.
- .4 Provide insulation and steel mesh complete with anchoring system as indicated. Secure cables to underside of wiring mesh.
- .5 Do not cross expansion joints with piping.
- .6 Do not alter heating piping length.
- .7 Ensure pipes do not bunch or cross.
- .8 Install all components, circulating pumps, controls, etc. in recessed enclosure as indicated.

### **3.2 FIELD QUALITY CONTROL**

- .1 Pressurize piping system during concrete pour.
- .2 Test system prior to concrete pour.
- .3 Install as per manufacturer's requirements.

### **3.3 START UP**

- .1 Manufacturer and Contractor to start up system and confirm proper operation. Submit start up reports to support proper operation.

### **3.4 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.



.2 Warranty Duration:

- .1 Two (2) year warranty period applies.
- .2 Tube shall carry a twenty-five (25) year non-prorated warranty against failure due to defect in material and workmanship. Manifolds and other ancillary components shall be warranted for eighteen (18) months from date of Ready for Takeover. Refer to Wirsbo's general conditions for the complete context of Wirsbo's "limited warranty".

.3 Warranty Coverage:

- .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL NOTES**

- .1 This section is to be read in conjunction with Division 1, the General Conditions, the Common Requirements of the Mechanical Trades, all of Division 23, the remainder of the Division 25 specifications/drawings and the documents required by the BIDDING REQUIREMENTS and CONDITION OF THE CONTRACT SECTIONS.
- .2 This contractor shall bid and work for the mechanical contractor as a sub-contractor.
- .3 When the work is covered as a Cash Allowance in the tender form, the successful Building Automation Contractor must accept the above terms of contract.

**1.2 BACNET INTEGRATION AND CONTROL POINTS**

- .1 The BAS contractor is responsible to provide a full and operable system that meets all required specifications and sequences.
- .2 The BAS contractor shall provide hard wired control points, sensors and all other components of the system as required to either supplement available BACNet points, or in the absence of a BACNet card make the system completely operable.
- .3 Sequences of operation may or may not be achievable through BACNet integration, as not all points required may be available from the unit manufacturer.
- .4 Not all equipment in the project has been specified with BACNet cards. The BAS contractor is responsible to review the entirety of the mechanical specification to confirm which equipment is being specified with BACNet integration cards and which equipment will not be provided with BACNet integration.
- .5 Quoting or pricing work as BACNet integration only is not acceptable.

**1.3 RELATED SECTIONS**

- .1 This contractor shall review work specified elsewhere in the mechanical specifications to confirm integration methodology:
  - .1 Sections Plumbing and Drainage
  - .2 Sections Ventilation and Air Conditioning
  - .3 Sections Testing and Balancing
  - .4 Sections Integrated Automation Systems
  - .5 Division 26 Electrical

**1.4 PRODUCTS FURNISHED BUT NOT INSTALLED BY BAS CONTRACTOR**

- .1 Hydronic Piping:
  - .1 Control Valves
  - .2 Flow Switches
  - .3 Temperature Sensor Wells and Sockets
  - .4 Flow meters.

- .2 Ductwork Accessories:
  - .1 Automatic Dampers
- .3 Variable Frequency Drives

**1.5 PRODUCTS INSTALLED BUT NOT FURNISHED BY THE BAS CONTRACTOR**

- .1 Air-Handling Equipment:
  - .1 Thermostats
  - .2 Duct Static Temperature Sensors
- .2 Gas Detection Systems.

**1.6 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THE BAS CONTRACTOR**

- .1 Heat Generation Equipment:
  - .1 Boiler Controls.
- .2 Refrigeration Equipment:
  - .1 Air Source Heat Pump (ASHP) System Controls.
- .3 Air-Handling Equipment (Air Handlers and Split System Heat Pumps):
  - .1 Set Point Reset.
  - .2 Volume Control.
- .4 Energy Recovery Ventilator (ERV):
  - .1 Defrost Control.
  - .2 Economizer / Bypass Control.
  - .3 Occupied / Unoccupied Indexing.
- .5 CRAC Unit and Associated Condensing Unit.

**1.7 WORK INCLUDED**

- .1 Provide all labour, materials, products, equipment and services to supply, install and commission the Building Management System, utilizing Direct Digital Control (DDC) and monitoring system with electronic actuation.
- .2 Provide all computer hardware and software, operator input/output communication devices, communication units, communication interface to digital system controllers, field sensors and controls as required to meet the specified performance.
- .3 Provide all labour, materials, products, equipment and services to supply, install and commission the electronic control and monitoring system to interface with the Owner's Operations Centre under Terminal Service Option communication protocol.
- .4 Provide all calibration, commissioning, software programming and data base generation of colour graphics and additional work necessary to provide a complete and fully operating system.

- .5 Provide all control wiring in accordance with Electrical Division as necessary to provide a complete and fully operating system as specified in this Section of the Specification.
- .6 120 Volt Wiring
  - .1 New Construction: BAS contractor is responsible to provide and install all 120 volt wiring required for the BAS system from designated junction boxes above electrical panels that have had breakers assigned to "BAS Power." BAS contractor shall review electrical drawings prior to tender. **Any additional breakers or power requirements shall be provided and installed by the electrical contractor at the BAS contractors cost to ensure warranty of the panels.**
  - .2 All wiring shall be to the standards of Division 26.
- .7 Obtain Ontario Hydro Permits for work specified in this Section of the Specification and submit final certificates in manual.
- .8 Surge transient protection shall be incorporated in design of system to protect electrical components.
- .9 **Provide uninterruptible power supply(s) (UPS) for DDC controls equipment provided under this contract.**
- .10 Testing, debugging, confirmation of total system operation and owner training on the complete operation of the system and the computer software shall also be provided in this section.

## 1.8 QUALITY ASSURANCE

- .1 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.
- .2 Install system using competent workmen who are fully trained in the installation of temperature control equipment. Single source responsibility of the supplier shall be the complete installation and proper operation of the DDC control system and BAS shall include debugging and proper calibration of each component in the entire system.

## 1.9 SHOP DRAWINGS

- .1 Product Data and Shop Drawings: Meet requirements of Section 15001 on Shop Drawings, Product Data, and Samples. In addition, Contractor shall provide shop drawings or other submittals on all hardware, and installation to be provided. No work may begin on any segment of this project until submittals have been successfully reviewed for conformity with the design intent.

- .2 Submittals shall be provided within 2 weeks of contract award. Submittals shall include:
  - .1 Direct Digital Control System Hardware:
    - .1 A complete bill of materials of equipment to be used indicating quantity, manufacturer, model number, and other relevant technical data.
    - .2 Manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for the items listed below and other relevant items not listed below:
      - .1 Direct Digital Controller (controller panels)
      - .2 Transducers/Transmitters
      - .3 Sensors (including accuracy data)
      - .4 Actuators
      - .5 Valves
      - .6 Relays/Switches
      - .7 Control Panels
      - .8 Power Supply
      - .9 Batteries
      - .10 Operator Interface Equipment
      - .11 Wiring
    - .3 Wiring diagrams and layouts for each control panel. Show all termination numbers.
    - .4 Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware.
  - .2 Central System Hardware and Software:
    - .1 A complete bill of material of equipment used, indicating quantity, manufacturer, model number, and other relevant technical data.
    - .2 Manufacturer's description and technical data, such as product specification sheets and installation/maintenance instructions for the items listed below and other relevant items not listed below:
      - .1 Central Processing Unit
      - .2 Power Supply
      - .3 Battery Backup
      - .4 Interface Equipment Between CPU and Control Panels
      - .5 Operating System Software
      - .6 Operator Interface Software
      - .7 Color Graphic Software
      - .8 Third-Party Software
      - .9 Software License

- .3 Schematic diagrams for all control, communication, and power wiring.
- .4 Riser diagrams of wiring between central control unit and all control panels.
- .5 A list of the color graphic screens to be provided. For each screen, provide a conceptual layout of pictures and data and show or explain which other screens can be directly accessed.
- .3 Controlled Systems:
  - .1 A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
  - .2 A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, it shall be labeled with the same name. All terminals shall be labeled.
  - .3 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 number, and product data sheet number.
  - .4 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.
  - .5 A point list for each system controller including both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, and the location of the I/O device. Software flag points, alarm points, etc.
  - .6 A list of trended points and alarms.
- .4 Provide a riser diagram showing the physical location of building control system equipment and the system architecture. DDC controller trunk conductors shall also be shown on a floor plan.
- .5 Testing and commissioning plan.
- .6 Provide 24 VAC power layout and load calculation for each transformer.

#### **1.10 REFERENCE STANDARDS**

- .1 Provide electrical material and installation in accordance with the appropriate sections of the current edition of the applicable local codes for signaling systems. Install wiring in conduit or approved totally enclosed raceways. Do not use cable raceways or troughs.
- .2 Provide materials and equipment, which are standard components regularly manufactured and guaranteed to be available as regular inventory as replacement parts.
- .3 Provide electrical and electronic equipment which is CSA or Ontario Hydro approved where such approvals are required by the regulatory authorities.
- .4 Provide ASCII American Standard for Communication and Information Interchange code input/output devices with standard EIA Electronic Industry Association interface.

**1.11 DOCUMENTATION – GENERAL**

- .1 Provide documentation for the BAS before the commencement of acceptance testing.
- .2 Provide two (2) sets of operator and programmer manuals to serve the diverse needs of personnel concerned with the operation, and maintenance of the facility.
- .3 Provide prior to project completion three (3) sets of maintenance documentation of a standard, which would enable the Owner to undertake planned maintenance, repair, calibration and other adjustments as may be necessary from time to time, on any component provided under this Contract without additional documentation being required and without assistance from others.

**1.12 AS BUILT DRAWINGS AND INFORMATION**

- .1 Upon completion of the work, the BMS Contractor shall submit three (3) copies of all Operating and Maintenance Manuals for equipment and materials supplied, and one set of "As- Built" plans showing reasonably exact routes of all cabling, specifications marked "As-Built", plans and specifications marked "As-Built".
- .2 Provide a manual divided into 3 sections describing the following functions:
  - .1 System Hardware Specification Manual, which provides a functional description of all hardware component installation/configuration with detailed instructions.
  - .2 System Operator's Manual, which provides concise instructions for operation of each system an explanation recovery route for all system alarms.
  - .3 System Data Manual, which provides the applications data, programmed into the system including a list of virtual points and a print out of the programs and point labels.
  - .4 A complete English language description of each control program for each system shall be provided. Clearly identify the function of each point reference used in the program for each system and/or equipment.
  - .5 Calibrate these points and establish units, limits and alarms;
  - .6 Incorporate these points in screen displays and reports;
  - .7 Incorporate these points in software sequences and control loops.
  - .8 Incorporate these points dynamically in graphic displays.
  - .9 Modify designation of control and virtual points.
- .3 A description of all maintenance procedures for each system's components, including inspection, periodic preventive maintenance, fault diagnosis and repair or replacement of defective module shall be provided. This shall include calibration, maintenance and repair of sensors, transmitters, transducers and panels plus diagnostics and repair or replacement of all system hardware.
- .4 Control damper schedules with construction details and dimensions. Identify dampers in accordance with specification and drawings. Dampers shall be identified as parallel or opposed blade, c/w frame style and actuator position.
- .5 Valve schedules with construction details calculated, CVs, selected valve CV pressure drops and flows.

- .6 Specifications and data sheets for all control system components including relays, switches, thermostats, controllers, dampers, indicators, flow switches, sensors and similar components.
  - .7 Two (2) copies of all software programs for controlled systems on disk.
  - .8 Revised points list, panel schedule and sequences of operations and all other information submitted with the original shop drawings, reflecting the “as built” condition.
- .1 The point list shall consist of the following information:

PHYSICAL POINT IDENTIFIER ON THE DDC	SIGNAL TYPE
POINT TYPE ( AI, AO, BI, BO)	TREND / TANTALIZATION
POINT NAME	ALARM
POINT DESCRIPTOR	CALIBRATED
PERIPHERAL DEVICE PART NUMBER	COMMISSIONED
WIRE NUMBER	
COMMENT	

- .2 **The as-built drawings shall consist of a single page showing the system architecture with BACnet (MSTP & I/P) network numbers, instance and MAC address.**

#### **1.13 Units**

- .1 All equipment and instrumentation shall be graduated in System International (SI) units.

#### **1.14 OWNERSHIP OF PROPRIETARY MATERIALS**

- .1 All project developed software and documentation shall become property of the owner. These include, but are not limited to:”
  - .1 Project graphic images
  - .2 As-built drawings
  - .3 Project database
  - .4 Project specific application programming code
  - .5 All documentation

#### **1.15 TRIAL USAGE**

- .1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 HVAC
  - .2 Exhaust air
  - .3 Domestic water
  - .4 Plumbing and drainage
  - .5 Controls System.



**1.16 DEFICIENCIES**

- .1 Refer to Division 1.
- .2 During the course of construction, the consultants will monitor construction and provide written reports of work progress, discussions, and instruction to correct work.
- .3 Instruction to correct work shall be done within the work period before the next review.
- .4 The contractor shall not conceal any work until inspected.
- .5 The contractor shall expedite 100% complete rough-in work and have inspected prior to concealing services and equipment especially above ceiling.
- .6 Upon completion of the project the consultant will do a final review. Upon receiving the final inspection report, the contractor must correct and sign back the inspection report indicating the deficiencies are completed. A re-inspection will only be done once consultant receives this in writing.

**1.17 READY FOR TAKEOVER**

- .1 Complete the following to the satisfaction of the consultant prior to request for ready for takeover.
  - .1 As-Built Drawings (see As Built Drawings and Information in this spec section for specific requirements for information to be included).
  - .2 Maintenance Manuals
  - .3 System Start up
  - .4 HVAC System Commissioning
  - .5 Instructions to Owners

**1.18 REVISION TO CONTRACT**

- .1 Provide the following:
  - .1 Itemized list of material with associated costs.
  - .2 Labour rate and itemized list of labour for each item.
  - .3 Copy of manufacturers/supplier's invoice if requested.

**1.19 REQUEST FOR INFORMATION (RFI) PROCEDURES**

- .1 RFIs shall be submitted to the consultant minimum two (2) weeks prior to answer being required. Failure to submit an RFI in a timely manner will forfeit delay claims and schedule extension requests by the contractor.
- .2 All RFIs will be submitted with the following information:
  - .1 RFI number
  - .2 Name of project
  - .3 Date of initiation
  - .4 Date response required by (minimum two (2) weeks)
  - .5 Subject
  - .6 Submitter's name

- .7 Drawing/specification reference
- .8 Photograph of the issue (if applicable)
- .9 Description of the issue
- .10 Contractor's proposed resolution

## **1.20 REGULATIONS, PERMITS, AND FEES**

- .1 All materials and quality of work shall meet all current and latest Provincial, Municipal and Fire Marshall requirements, regulations, codes, and by-laws in force in the area of the project.
- .2 Each contractor shall give all necessary notices, obtain all necessary permits, and pay all fees in order that the work shown or specified may be carried out. Each contractor shall furnish any certificates necessary as evidence that the work installed conforms with the laws and regulations of all authorities having jurisdiction.
- .3 In the event that changes or alterations are required on completed work by authorized inspectors, these changes shall be made at the contractor's expense.
- .4 Special equipment which does not have a standard CSA label shall be inspected by the local electrical authority having jurisdiction and the Approval Certificate shall be submitted to the Consultant as soon as possible. All costs and fees for inspections shall be borne by this contractor.

## **Part 2 Products**

### **2.1 ACCEPTABLE MANUFACTURERS**

- .1 The following are the approved Control System Contractors and Manufacturers

<b>Company Name</b>	<b>Manufacturer</b>	<b>Location</b>	<b>Contact</b>
Convergint	Schneider	Brantford	Patrick Cousineau (519-754-7408)

- .2 Notes

- .1 The contractor shall use only products from the corresponding manufacturer and product line listed.
- .2 The above list of manufacturers applies to operator workstation software, controller software, the custom application program language and controllers.
- .3 All other products specified in the Building Automation specifications need not be manufactured by the above manufacturers (i.e. sensors, valves, dampers and actuators)

## **2.2 DESCRIPTION OF SYSTEM**

- .1 The BAS shall include control of the following systems as detailed in this Section of the Specification under Sequence of Operation:
  - .1 CENTRAL PLANT
    - .1 Heating Water Plant consisting of
      - .1 Boilers.
      - .2 Heating System Pumps and loop.
    - .2 Air Source Heat Pump (ASHP) Loop consisting of:
      - .1 Air Source Heat Pumps (ASHPs).
      - .2 Heat Exchangers (by ASHP manufacturer).
      - .3 Circulation Pumps.
    - .3 Domestic Hot Water Circulation Pump and Boilers
  - .2 FAN PLANT
    - .1 Air Handling Units.
    - .2 HVAC Equipment.
    - .3 Energy or Heat Recovery Units.
  - .3 FLOOR LEVEL CONTROL
    - .1 Motorized Control Dampers.
    - .2 Heat Pumps.
    - .3 Vestibule Heaters.
    - .4 Dx Split Systems.
    - .5 Supply, Return and Exhaust Fans.
    - .6 In-Floor Heating System and Manifolds.
    - .7 Reheat Coils.
    - .8 Unit Heaters.
    - .9 Multi-Head Air Conditioning / Heating Systems.
    - .10 Misc. Mechanical and Electrical Room Temperature Control.
  - .4 OUTDOOR LIGHTING
  - .5 INDOOR LIGHTING CONTROL
  - .6 FIRE PANEL MONITORING
  - .7 SECURITY MONITORING
  - .8 UTILITY MONITORING
    - .1 Switchboard electrical meter monitoring.
    - .2 Gas meter monitoring.
    - .3 Domestic water meter monitoring.
  - .9 Fire/Smoke damper monitoring.
- .2 Refer to sequences of operation section for full description of systems.

## **2.3 LICENSE**

- .1 The system shall be licensed to the owner.
- .2 Provide license for minimum of three years.

## **2.4 GENERAL SYSTEM REQUIREMENTS**

- .1 All applications programs shall be pre-engineered and pre-tested.
  - .1 All the controllers used on the project must use the same programming language, and programs developed for one model of controller must be cross platform transferable to any other model of controller that has sufficient RAM and suitable input/output points.
- .2 Temperature control system shall be completely microprocessor based Direct Digital Control (DDC) electrically and /or electronically operated except where otherwise stated. System shall be installed by competent mechanics and electricians regularly employed by the BMS Company. Energy management system shall be an integral part of BMS.
- .3 In event of power or system failure, equipment shall fail safe, and heating valves open, dampers closed, cooling off. Provide spring return feature on all valves to ensure this condition. (Exception: valve and damper actuators on radiation, reheat valves, etc.) Floating point valves shall not be accepted. Wax valves shall not be acceptable
- .4 All system hardware and associated equipment shall be standard OEM items regularly manufactured for this and/or other systems and not custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use. All electronic circuits shall be self-diagnostic.
- .5 Design scope documents establish minimum acceptable system and component capability. They are not all inclusive. All additional construction, equipment, interfaces and software required for a complete and operating systems providing the specified functions are required.
- .6 The fire/life safety system (F/LS) shall have priority with respect to control of equipment that is subject to control by both the F/LS and BMS. The BMS Contractor shall coordinate installation of the BMS to ensure that interfacing and connection of BMS to such equipment and H-O-A switches shall not pass or interfere with F/LS operation under either normal mode or failure mode operation of the BMS.
- .7 Freeze stats and other safety controls shall have priority with respect to control of equipment that is also controlled by the BMS. Contractor shall co-ordinate installation of the BMS to ensure that interfacing and connections of the BMS and H-O-A switches to such equipment shall not by-pass or interfere with freeze stats or other safety controls.

- .8 System shall be fully modular, permitting point expansion by adding computer memory, remote terminal units, or applications software without obsolescence of existing communication or processing equipment.
  - .1 Provide licences for the software packages normally used by the BMS contractor to create, modify and add programming and graphics to the system. The software shall enable owner to add points to system and to program complex routines. Owner shall be able to add and modify all point information. Owner accessible software shall include:
    - .1 Direct Digital Control Library.
    - .2 Report Generation Library.
    - .3 Energy Management Library.
    - .4 Graphics Library.
    - .5 Programming Tool.
    - .6 Engineering Graphics Tool.
  - .2 Once programmed, the results may be used to start/stop points, and readjust set points, sequence equipment, report abnormal conditions, etc.
- .9 Set points and values given are for initial set-up only. All points shall be adjustable from the operator workstation.
- .10 All electrical and electronic components shall be CSA; ULC, UL or Ontario Hydro approved where such approvals are required by the regulatory authorities.
- .11 Failure of any Direct Digital Controller Unit (DDC) or its communication link in the system shall not affect the proper operation of the operator workstation or any other Direct Digital Controllers.
- .12 If the Host Computer (CPU) or transmission network fails but power to the DDC does not, the DDC shall continue to monitor all changes of state and/or values and shall retain the most recent values. The DDC shall also maintain all analog set points and command positions.
- .13 Components shall not require any customizing other than setting of jumpers and switches, adding of firmware modules or software modules or any software programming to perform required functions. System shall be a true distributed processing system without any form of network management device used. All software control functions shall be performed by intelligent field panels and by intelligent unit controllers as appropriate.

## **2.5 GENERAL MATERIALS REQUIREMENTS**

- .1 The CPU and peripheral equipment shall operate in the following conditions:
  - .1 Temperature 15 C to 27 C
  - .2 Humidity 20% to 80% (non condensing)
  - .3 Power 120 VAC +/-10%
  - .4 Frequency 60HZ +/-3HZ
  - .5 Power factor 0.6 to 1.0

- .2 Local field panels and peripheral equipment shall be rated to operate in following conditions:
  - .1 Temperature 0° C to 50° C
  - .2 Humidity 10% to 90% RH (non condensing)
  - .3 Power 120 VAC + 10% on primary side of control transformers and plus or minus 25% of nominal voltage on the secondary side.
  - .4 Frequency 60 Hz + 3 Hz
  - .5 Power Factor 0.6 to 1
- .3 Controls shall be D.D.C. solid state type as noted elsewhere, and with exception of actuators, contain no moving parts.
- .4 Sensor accuracy shall be within 0.6% of maximum range, maximum  $\pm 0.25^{\circ}\text{C}$ . Mixed air sensors must give a true average across duct cross section.

## 2.6 GENERAL SYSTEM PERFORMANCE REQUIREMENTS

- .1 Comply with the following performance requirements:
  - .1 Graphic Display: Display graphic with minimum 20 dynamic points with current data within 5 seconds.
  - .2 Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 5 seconds.
  - .3 Object Command: Reaction time of less than 5 seconds between operator command of a binary object and device reaction.
  - .4 Object Scan: Transmit change of state and change of analogue values to control units or workstation within 5 seconds.
  - .5 Alarm Response Time: Annunciate alarm at workstation within 2 seconds. Multiple workstations must receive alarms within five seconds of each other.
  - .6 Program Execution Frequency: Programmable controllers shall execute DDC PI control loops, and scan and update process values and outputs at least once per second.
- .2 Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
  - .1 Water Temperature: Plus or minus  $0.25^{\circ}\text{C}$ .
  - .2 Water Flow: Plus or minus 5% of full scale.
  - .3 Water Pressure: Plus or minus 2% of full scale.
  - .4 Space Temperature: Plus or minus  $0.25^{\circ}\text{C}$ .
  - .5 Ducted Air Temperature: Plus or minus  $0.25^{\circ}\text{C}$ .
  - .6 Outside Air Temperature: Plus or minus  $0.5^{\circ}\text{C}$ .
  - .7 Temperature Differential: Plus or minus  $0.25^{\circ}\text{C}$ .
  - .8 Relative Humidity: Plus or minus 2%.
  - .9 Air Pressure (Ducts): Plus or minus 0.1-inch wg.
  - .10 Carbon Monoxide: Plus or minus 5% of reading.

- .11 Carbon Dioxide: Plus or minus 50 ppm.
- .12 Electrical: Plus or minus 5% of reading.

## **2.7 INTEGRATED LIFE SAFETY SYSTEMS TESTING**

- .1 Systems in this building, including but not limited to smoke control dampers, smoke control fans, high speed low velocity ceiling fans, makeup air units, heat tracing for fire protection systems and fire protection system components may be subject to Integrated Life Safety Systems testing.
- .2 This contractor shall co-ordinate with the Integrated Life Safety Systems Testing Agent as follows:
  - .1 Confirm which mechanical systems are to be included as part of the testing process.
  - .2 Verify in writing to the Integrated Life Safety Systems Testing Agent that mechanical commissioning of the affected systems/devices is complete prior to the scheduled testing date(s).
  - .3 Participate in the Integrated Life Safety Systems Testing to confirm proper operation of all associated systems.
  - .4 This contractor shall work with the Integrated Life Safety Systems Testing Agent to reset all systems back to normal operating mode after the testing is complete.
- .3 Include all costs associated with Integrated Life Safety System Testing in the tender value.
- .4 Refer to Division 1/Division 26 Integrated Life Safety Systems Testing specifications for additional information/requirements.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/consultant for resolution before rough-in work is started.
- .2 The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the consultant for resolution before rough-in work is started.
- .3 The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate-or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others-the contractor shall report these discrepancies to the consultant and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by-and at the expense of-this contractor.

### **3.2 A2L REFRIGERANT CONTAINING EQUIPMENT**

- .1 A2L refrigerants are classified as mildly flammable. CSA B52-2023 has specific safety clauses related to the use of refrigerants with this classification within buildings.
- .2 This contractor shall be responsible to ensure that the installation requirements of CSA B52-2023 are met.
- .3 Throughout this specification various pieces of equipment have been specified with refrigerant leak detection systems. Field wiring of the alarm status of this system to various downstream system components is required under Annex P of the standard and is the responsibility of this contractor. These devices include the following:
  - .1 Open all zone dampers connected to the affected system.
  - .2 Disable electric reheat coils within the affected system.
  - .3 Activate field installed safety shut off valves on the affected refrigeration systems
  - .4 De-energize any potential sources of ignition with the ductwork system of the affected system.
  - .5 Energize fans within the ductwork system.
  - .6 Activate any designated refrigeration leak ventilation systems.

### **3.3 VERIFICATION OF REFRIGERATION LEAK DETECTION SYSTEM OPERATION**

- .1 The commissioning process shall include the verification of the refrigeration leak detection system.
- .2 All interlocks between leak detection systems installed and system components, as well as interlocks between field installed detection systems and associated safety system components shall be tested and verified to operate as per the requirements of CSA B52. Specifically, the following shall occur for each independent system on registration of a refrigerant leak:
  - .1 Open all zone dampers in the affected system.
  - .2 Disable all electric reheat coils within the affected system.
  - .3 Activate field installed safety shut off valves within the affected refrigeration system.
  - .4 Energize all fans within the affected ductwork system.
  - .5 Activate and refrigerant leak system specific ventilation systems.
  - .6 De-energize any other potential sources of ignition within the affected system.

### **3.4 PROTECTION**

- .1 The contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.
- .2 The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.



### **3.5 INSTALLATION**

- .1 Install all equipment, accessories, conduit and interconnecting wiring in a neat and protected manner by skilled and qualified work persons using the latest standard practices of the industry.
- .2 Meet Owner's requirements.
- .3 Cooperate with the air and water balance technicians during the balancing of the system.
- .4 Trip test high and low temperature protection devices to ensure satisfactory operation, in the presence of the Owner.
- .5 Unless otherwise specified, meet manufacturer's latest printed instructions for materials, planned maintenance and installation methods.
- .6 Notify Consultant in writing of any conflict between these Specifications and manufacturer's instructions.
- .7 Install equipment so as to allow for easy maintenance access and such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .8 Shield and ground communication trunk wiring at a single end.
- .9 Do not splice trunk line.
- .10 Provide complete installation, testing, debugging and interfacing of specified software.

### **3.6 LABELLING**

- .1 Provide engraved black and white Lamicoid plastic nameplates, 25 x 65 mm minimum at all duct mounted instruments, reset controls, thermometers and panels so as to clearly indicate service of particular device. All manual switches unless they come with standard nameplate shall be similarly labeled.

### **3.7 NAMING**

- .1 Object and Point Naming
  - .1 All BACnet objects and points programmed under these specifications, shall conform to the following case sensitive convention:
    - .1 First group of characters = Building Unique Identifier (Enterprise systems only)
    - .2 Second group of characters = Network number
    - .3 Third group of characters = Device number
    - .4 Fourth group of characters = Controller / Equipment Identifier
    - .5 Last segment = Point name abbreviation
  - .2 Example: S1156\_2\_15\_HP10\_RmTemp
  - .3 Object name segment shall be delimited by ( ) character, however, must be consistent by Vendor across all owner sites

- .2 Controller and Device Addressing and Naming
  - .1 Each device or network installed and programmed under these specifications, shall be addressed and/or named as follows:
    - .2 Device Instance
      - .1 First group of characters = Building Unique Identifier (Enterprise systems only)
      - .2 Second group of characters = Network number
      - .3 Third group of characters = Device number
      - .4 Fourth group of characters = Controller / Equipment Identifier
      - .5 Example: S1156\_2\_15\_HP10
    - .3 BACnet Network Number
      - .1 First group of characters = Building Unique Identifier (Enterprise systems only)
      - .2 Second group of characters = Network number
      - .3 Third group of characters = Network and Type
      - .4 Example: S1156\_2\_1 (S1156 = Forest Trail, 2 = Network 2, 1 = 1st MS/TP network)
    - .4 MAC Addresses
      - .1 B-BC
      - .2 Maintenance Connection
      - .3 Reserved
      - .4 -127. Master Range
      - .5 128.– 254. Slave Range
      - .6 255. Broadcast
    - .5 Object name segment shall be delimited by ( ) character, however, must be consistent by Vendor across all owner sites
  - .3 Controller and Equipment identifiers shall match the standard adopted within the owner's enterprise level network. In the case of no enterprise level network or owner standard identifiers shall match the drawings.

### 3.8 COORDINATION

- .1 Site
  - .1 Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.
  - .2 Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

- .2 Submittals. Refer to the “Submittals” article in Part 1 of this specification for requirements.
- .3 Test and Balance
  - .1 The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
  - .2 The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
  - .3 In addition, the contractor shall provide a qualified technician to assist in the test and balance process.
  - .4 The tools used during the test and balance process will be returned at the completion of the testing and balancing.
  - .5 During the system testing and balancing by an independent agency fully demonstrate the operation of all sensors, dampers, actuators, controls, valves, etc. This contractor shall be present during the testing and balancing and make adjustments as often as necessary to satisfy the testing and balancing agency.
- .4 Life Safety
  - .1 Duct smoke detectors required for air handler shutdown are supplied under the mechanical section of this specification. The contractor shall interlock smoke detectors to air handlers for shutdown as described in Part 3, “Sequences of Operation.”
  - .2 Smoke dampers and actuators required for duct smoke isolation are provided under mechanical section. The contractor shall interlock these dampers to the air handlers as described in Part 3, “Sequences of Operation.”
  - .3 Fire/smoke dampers and actuators required for fire rated walls are provided under another Section of mechanical section. Control of these dampers shall be by electrical. The contractor shall monitor the position of these dampers.
- .5 Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
  - .1 All communication media and equipment shall be provided as specified in Part 2, “Communication” of this specification.
  - .2 Each supplier of a controls product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.
  - .3 The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.

- .4 The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
- .5 The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

### **3.9 ACCEPTANCE TESTING**

- .1 Upon completion of the system control contractor will request, in writing, to the Engineer and Owner that the acceptance procedures can commence.
- .2 After installation forward submittal data relevant to point index, functions, limits, sequences, interlocks, software routines and associated parameters and other pertinent information for the operating system and data base to the Owners authorized representative. Enter software into the central computer and debug.
- .3 Prior to on-line operation perform a complete demonstration and readout of the computer real-time responsibilities of surveillance and command in the presence of the Owner's authorized representative.
- .4 Adjust all devices and components to ensure that the operations are performed correctly and that all analog values are displays to the accuracy specified. Check all alarms, start/stop and status conditions to ensure proper operation.
- .5 Upon successful completion of on-line operation provide the Owner's authorized representative with written confirmation, inspection and approval of the satisfactory operation of the building automation system.
- .6 Complete all outstanding deficiencies as determined by the Owner's representative in his inspection report, after which a resubmission of formal acceptance shall be made. Repeat this procedure, if necessary, until acceptable performance has been established.

### **3.10 CONTROL SYSTEM CHECKOUT AND TESTING BY BAS CONTRACTOR**

- .1 Start-up Testing: All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. Submit test worksheets to the consultant. This testing shall be completed before the owner's representative is notified of the system demonstration.
  - .1 The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
  - .2 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
  - .3 Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.
  - .4 Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are rect.

- .5 Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
- .6 Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum start/stop routines.
- .7 Alarms and Interlocks:
  - .1 Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
  - .2 Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
  - .3 Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
- .2 Submit copies of test sheets to the consultant and include in as-built information.

### **3.11 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE**

- .1 Verify to the Owner's Representative and Architect/Engineer in letter form that supplier has in place support facility. Letter shall show location of support facility, name and titles of technical staff, engineers, supervisors, fitters, electricians, managers and all other personnel responsible for the completion of the work on this project.
- .2 Demonstration
  - .1 Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
  - .2 The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The consultant will be present to observe and review these tests. The consultant shall be notified at least 10 days in advance of the start of the testing procedures.
  - .3 The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
  - .4 The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.

- .5 As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
- .6 Demonstrate compliance with Part 1, "System Performance."
- .7 Demonstrate compliance with sequences of operation through all modes of operation.
- .8 Manually generate an alarm at a remote DDC Controller as selected by the Architect/Engineer to demonstrate the capability of the workstation and alarm printer to receive alarms within 5 seconds.
- .9 Disconnect an operator workstation in the central control room and manually generate an alarm at a remote DDC Controller to demonstrate the capability of the system printer to receive alarms when the workstation is disconnected from the system.
- .10 Disconnect one DDC Controller from the network to demonstrate that a single device failure shall not disrupt or halt peer to peer communication. Panel to be disconnected shall be selected by the Architect/Engineer.
- .11 At an ASC of the Architect/Engineer's choice, disconnect the LAN connection to demonstrate its lack of reliance on a DDC Controller to maintain full control functionality.
- .12 Demonstrate complete operation of operator interface.
- .13 Additionally, the following items shall be demonstrated:
  - .1 DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
  - .2 Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
  - .3 Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
  - .4 Interface to the building fire alarm system.
  - .5 Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/consultant. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

- .14 Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

.3 Acceptance

- .1 All tests described in this specification shall have been performed to the satisfaction of both the consultant and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the consultant. Such tests shall then be performed as part of the warranty.

**3.12 TRAINING**

- .1 The Contractor shall provide a competent instructor to give full instruction to designated personnel in the adjustment, operation and maintenance of the system installed, rather than a general training course.
- .2 Provide 16 hours of training for Owner's operating personnel. Training shall include:
  - .1 Explanation of drawings, operations and maintenance manuals
  - .2 Walk-through of the job to locate control components
  - .3 DDC Controller
  - .4 Explanation of adjustment, calibration and replacement procedures
  - .5 Review of Operator Work Station Functions (set point adjustment, scheduling etc.)
- .3 Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor. If such training is required by the Owner, it will be contracted at a later date. Provide description of available local and factory customer training.

**3.13 WARRANTY AND SERVICE**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warrant in writing, all provided equipment, accessories, installations, software, and firmware against defects in workmanship and materials for a period of one year commencing from the date of issue of the Certificate of Substantial Performance.
- .4 Maintain the affected parts operational during repair of defective equipment covered by the warranty.

- .5 Provide warranty service at no cost to the owner for the guarantee period, this shall include, but not limited to the following:
  - .1 Repair service on hour basis during warranty. Provide emergency service where malfunction would result in property damage. If not emergency, respond to site within 24 hours and resolve issue within three (3) days.
  - .2 Replacing defective parts and components as required.
  - .3 Servicing by factory trained and employed service representatives of system manufacture.
- .6 Supplier shall have an in-place support facility within 100 km of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.
- .7 Provide all labour, associated travel and expenses, materials, and equipment necessary for the successful operation of this system for a period of 12 months from the date of Ready for Takeover.
- .8 **In addition, provide three (3) visits for testing and evaluating the performance of the hardware and software installed per this specification, to be coordinated with the owner's Building Automation Manager. One visit shall be during the cooling season, one visit shall be during the heating season, and one visit shall be during a shoulder season, either spring or fall. Provide a written report after each visit is complete. This service visit shall include, but not be limited to, the following:**
  - .1 **Check calibration and re-calibrate if needed instrumentation sensors for air flow, liquid flow, pressure, humidity, temperature, and transducers. Written records shall be kept indicating the performance of such calibrations along with pertinent data.**
  - .2 **Check the operation of dampers and damper actuators to assure no lock up has occurred and stroke is proper. Written records shall be kept indicating the performance of such calibrations along with pertinent data.**
  - .3 **Check the overall system field operations by performing a review of all points. Verify that all monitoring and command points are valid and active. Written records shall be kept indicating the performance of such exercises.**
- .9 If a problem develops at any time during the warranty/service period, the affected BAS point/object shall be monitored and logged for the remainder of the warranty/service period. "A problem" in the above statement will refer to an incident in which any of the following occur:
  - .1 An alarm occurs due to a defective control system component(s), improper installation or programming.
  - .2 Overall performance of the system is compromised due to a defective control component(s), improper installation or programming.
  - .3 Major recalibration (by greater than 5 times the catalogued accuracy) is required for a sensor during one of the service visits.



- .4 Changes required to meet design, compliance, and functionality, that were not part of the Demonstration and Acceptance process, will be made at no cost to the Owner.
- .5 Any changes to programming, inclusive of but not limited to set-points, schedules, sequences, alarms, history, network addressing, object naming, etc.
- .10 Run all diagnostics and correct all previously diagnosed problems.
- .11 Resolve and correct any previous outstanding problems.
- .12 Software: Provide all software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and shall be incorporated into the operations and maintenance manuals, and software documentation.
- .13 Warranty Coverage:
  - .1 Applies to parts and labour.

### **3.14 WARNING LABELS**

- .1 Permanent warning labels shall be affixed to all equipment that can be automatically started by the DDC system.
  - .1 Labels shall use white lettering (12-point type or larger) on a red background.
  - .2 Warning labels shall read as follows:  
**CAUTION**  
“Operating under automatic control”. “Switch disconnect to “Off” position before servicing”.
- .2 Permanent warning labels shall be affixed to all motor starters and all 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**  
“Fed from more than one power source”.

### **3.15 CLEANING**

- .1 The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- .2 At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

- .3 At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.
- .4 All equipment shall be cleaned, including interior and exterior surfaces at completion of the work.

**END OF SECTION**

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**Part 1            General**

**1.1            GENERAL**

- .1        This section is to read in conjunction with Division 1, the general condition, and the General Requirements of the mechanical trades.

**1.2            REFERENCES**

- .1        Tested to ANSI/UL Standard 508.
- .2        UL-508 certified for the building and assembly.
- .3        CSA or C-UL stickers shall be applied to both the VFD and option panels.
- .4        Manufacturers shall be ISO 9001 certified facilities.

**1.3            SUBMITTALS**

- .1        Submit manufacturer's performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's FLA rating, certification agency file numbers and catalogue information.
- .2        The specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.
- .3        Harmonic filtering. The manufacturer shall, with the aid of the buyer's electrical power single line diagram, providing the data required by IEEE-519, perform an analysis to initially demonstrate the supplied equipment will meet the IEEE standards after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the bid. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

**Part 2            Products**

**2.1            ACCEPTABLE MANUFACTURERS**

- .1        Danfoss Graham.
- .2        ABB.
- .3        AC Tech.

## **2.2 GENERAL**

- .1 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.
- .2 With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFD's utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
- .3 Include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
- .4 Provide DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFD's without DC link reactors shall provide a minimum 5% impedance line reactor.
- .5 Full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
- .6 Provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.
- .7 An automatic energy optimization selection feature shall be provided in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
- .8 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.
- .9 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.
- .10 Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFD's not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.
- .11 VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
- .12 VFD's operating 600/3/60 motors not designed to meet Nema MG1 Part 31 should include Output dv/dt (LC) Reactors.

## **2.3 PROTECTIVE FEATURES**

- .1 VFD shall be provided with an integral disconnect and Integral Fast Blow Semi-Conductor fuses sized as specified by ULC. Fuses shall be Bussman JJS type or equivalent.
- .2 A minimum of Class 20 I2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.
- .3 Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over-voltage, under-voltage, VFD over-temperature and motor over-temperature. The VFD shall display all faults in plain English. Codes are not acceptable.
- .4 Protect VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal.
- .5 The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
- .6 To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Motors shall have inverter rated insulation (1600V).
- .7 VFD shall include a “signal loss detection” circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC and shall be programmable to react as desired in such an instance.
- .8 VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
- .9 VFD shall catch a rotating motor operating forward or reverse up to full speed.
- .10 VFD shall be rated for 100,000 amp interrupting capacity (AIC).
- .11 VFD shall have externally mounted EMI electromagnetic suppressor to limit the EMI and RFI output from the VFD. VFD to be mounted in an all metal cabinet to limit radiated RFI.
- .12 VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
- .13 VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt VFD's, and 701V AC on 575 volt VFD's.
- .14 For remote VFD installations, provide an output filter (load side reactor) at each VFD to protect the equipment motor. Coordinate installation with equipment manufacturer.

## **2.4 INTERFACE FEATURES**

- .1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.
- .2 The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.
- .3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

- .4 Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.
- .5 The keypads for all sizes of VFD's shall be identical and interchangeable.
- .6 To set up multiple VFD's, it shall be possible to upload all set-up parameters to the VFD's keypad, place that keypad on all other VFD's in turn and download the set-up parameters to each VFD. To facilitate setting up VFD's of various sizes, it shall be possible to download from the keypad only size independent parameters.
- .7 Display shall be programmable to display in 9 languages including English, Spanish and French.
- .8 The display shall have four lines, with 20 characters on three lines and eight large characters on one line.
- .9 A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- .10 A quick set-up menu with factory preset typical HVAC parameters shall be provided on the VFD eliminating the need for macros.
- .11 The VFD shall include a standard RS-485 communications port for connection to a Johnson Controls N2 and Siemens FLN serial communication system. The connection shall be software selectable and addressable by the user. The option for Lonworks and BacNet communication must also be available.
- .12 As a minimum, the following points shall be controlled and/or accessible:  
VFD Start/Stop, Speed reference, Fault diagnostics, and Meter points as follows:  
Motor power in HP, Motor power in kW, Motor kW-hr, Motor current, Motor voltage, Hours run, Feedback signal #1, Feedback signal #2, DC link voltage, Thermal load on motor, and Thermal load on VFD, Heat sink temperature.
- .13 Four additional Form C 230 volt programmable relays shall be available for factory or field installation within the VFD.
- .14 Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
- .15 Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
- .16 Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFD's unable to show these four displays simultaneously shall provide panel meters.
- .17 Sleep mode shall be provided to automatically stop the VFD when its speed drops below set "sleep" level for a specified time. The VFD shall automatically restart when the speed command exceeds the set "wake" level.
- .18 The sleep mode shall be functional in both follower mode and PID mode.

- .19 Run permissive circuit shall be provided to accept a “system ready” signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
- .20 The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, DC Bus Voltage, VFD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VFD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.
- .21 The display shall be programmed to read in inches of water column (in-wg) for an air handler application, pressure per square inch (psi) for a pump application, and temperature (oF) for a cooling tower application.
- .22 VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.
- .23 If the temperature of the VFD’s heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD’s heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.
- .24 The VFD shall have temperature controlled cooling fans for quiet operation and minimized losses.
- .25 The VFD shall store in memory the last 10 faults and related operational data.
- .26 Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
- .27 Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VFD status.
- .28 Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.
- .29 Two programmable 0 to 20 mA analog outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.
- .30 Under fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed.
- .31 A contact/relay shall be provided to shut the fans down upon fire alarm signal.

## **2.5 ADJUSTMENTS**

- .1 VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.

- .2 Sixteen preset speeds shall be provided.
- .3 Four acceleration and four deceleration ramps shall be provided. Accel and decel time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.
- .4 Four current limit settings shall be provided.
- .5 If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: under-voltage, over-voltage, current limit and inverter overload.
- .6 The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
- .7 An automatic “on delay” may be selected from 0 to 120 seconds.

## **2.6 SERVICE CONDITIONS**

- .1 Unit shall operate in ambient temperature of -10°C to 40°C (14°F to 104°F).
- .2 Unit shall operate in 0 to 95% relative humidity, non-condensing.
- .3 Operate in elevation up to 3,300 feet without derating.
- .4 Maximum AC line voltage variation, -10 to +10% of nominal with full output.
- .5 No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

## **2.7 FACTORY TESTING**

- .1 To ensure quality and minimize infantile failures at the jobsite, the manufacturer shall test the complete VFD. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.
- .2 All optional features shall be functionally tested at the factory for proper operation.

## **2.8 BYPASS SWITCH**

- .1 Bypass Controller - Automatic transfer to line power via contactors. When in the “Drive” mode, the bypass contactor is open and the drive output contactor is closed. In the “Bypass” position, the drive output contactor is open, and the bypass contactor is closed via Start/stop command. Start/stop via customer supplied maintained contact shall be Dry type 115V compatible and shall function in both the “Drive” and “Bypass” modes. The design shall include single-phase protection in both the VFD and bypass modes.



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**Part 3            Execution**

**3.1            START-UP SERVICE**

- .1      The manufacturer shall provide start-up and commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

**3.2            EXAMINATION**

- .1      Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.

**3.3            INSTALLATION**

- .1      Install to manufacturer's recommendations.
- .2      Install to the requirements of the local Hydro codes. Obtain hydro permits and pay all fees.
- .3      Install in an accessible location and proper service height from floor.
- .4      Install in clean, dry, and conditioned environment.
- .5      The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.
- .6      Wiring of devices to be to the standards of Electrical Division.
- .7      Provide one manufacturer of VFD's throughout the project.

**3.4            WARRANTY**

- .1      Warranty Start Date:
  - .1      Warranty period starts as of the date of Ready for Takeover.
  - .2      Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2      Warranty Duration:
  - .1      Two (2) year warranty period applies.
  - .2      The VFD shall be warranted by the manufacturer for a period of five (5) years from date of Ready for Takeover. The warranty shall include parts, labour, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

.3      Warranty Coverage:

- .1      Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA 22.2 No. 152 Combustible Gas Detection Instruments.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
  - .1 Electrical power supply.
  - .2 Installation instructions.
  - .3 Control function.

**Part 2 Products**

**2.1 CO AND NO2 MONITOR**

- .1 Dual or single channel gas monitoring system with remote solid state carbon monoxide sensor and remote electrochemical nitrogen dioxide sensor/transmitter. Each set of sensors shall control exhaust fan(s).
- .2 Unit shall include:
  - .1 Monitoring panel
    - .1 Monitor shall be enclosed in NEMA 12 cabinet.
    - .2 Dual alarm trip points (CO trip points will be at 25 and 100 ppm, NO2 trip points will be at 1 ppm and 3 ppm).
    - .3 Dual DPDT 10A relays for alarm actuation and control of ventilation equipment and/or auxiliary alarms. Connect alarm to respective exhaust fan.
    - .4 LEDs indicating power on, low and high alarms, and fail, plus a user selectable audio indicator capable of being silenced for high alarm.
    - .5 Test sequence activated by single push button.
    - .6 Alarms shall be equipped with user selectable time delays whereby, when chosen, low and high alarm conditions must prevail for five and ten minutes respectively before activation occurs.
    - .7 Alarms shall be equipped with dead band which requires gas levels to decline slightly below the original trip point before alarms will automatically reset.
  - .2 Carbon monoxide sensor
    - .1 Range of 0 – 100 ppm CO.
    - .2 Solid state type sensor.

- .3 Three wire hook-up.
- .4 Capable of covering up to 697 m<sup>2</sup> (7500 ft<sup>2</sup>).
- .5 To be mounted 1.2 m to 1.8 m (4' to 6') above floor level (breathing zone) to OBC requirements.
- .3 Nitrogen dioxide sensor/transmitter
  - .1 4 m to 20 m (13' 4" to 6' 8") A linear signal output corresponding to 0 – 10 ppm NO<sub>2</sub>.
  - .2 Electrochemical type sensor.
  - .3 Remote calibration feature with non-interactive zero and span.
  - .4 Two wire hook-up.
  - .5 Capable of covering up to 697 m<sup>2</sup> (7500 ft<sup>2</sup>).
  - .6 To be mounted 1.2 m to 1.8 m (4' to 6') above floor level (breathing zone) to OBC requirements.
- .3 Type and placement: as indicated.
- .4 Acceptable materials:
  - .1 Armstrong Monitoring Corporation Model #1022-D monitor with #AMC-1220 carbon monoxide sensor and #AMC-1220 nitrogen dioxide sensor/transmitter.
  - .2 Mine Safety Appliances Model TGM combo panel and 215068 CO sensors with 212569 NO<sub>2</sub> sensors.
  - .3 Vulcain
  - .4 FCS Gas detection system by Critical Environment Technologies
  - .5 Belimo

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 Install in accordance with manufacturer's recommendations.
- .2 Install in accordance with CSA standards and local authorities requirements.
- .3 Field test system to verify operation in presence of manufacturer.
- .4 Install in accordance to local hydro requirements and the Electrical Safety Code.
- .5 Install wiring in EMT conduit to the standards of the Electrical Division.
- .6 Mount devices at height required to properly detect gas.

#### **3.2 COMMISSIONING**

- .1 Prove operation at each sensor for all relevant gasses.
- .2 Prove Stage 1 Detection in each zones. System shall demonstrate the following:
  - .1 Zone intake and exhaust motorized dampers are interlocked, engaged, and fully operable.
  - .2 Zone exhaust fans are interlocked, engaged, and fully operable.

- .3 Prove Stage 2 Detection in each zone.
  - .1 Local detectors provide audible and visual alarm.
  - .2 Dampers remain open and exhaust fans remain operable.
- .4 Prove Stage 3 Detection in each zone
  - .1 When local detectors sense Stage 3 concentrations of toxic gases, all sensors in building will provide audible and visual alarm.
  - .2 Dampers remain open and exhaust fans remain operable.
- .5 Prove gas detectors enter a local alarm when in a fault condition.
- .6 Prove that all detectors audible alarm can be silenced by main gas detector control panel.
- .7 Submit supporting documents to local authority and consultants, signed by testing agency.

### **3.3 WARRANTY**

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 All components shall be CSA certified and carry a full two (2) year warranty against defects in labour and workmanship. Electrochemical sensors (NO2) shall carry a two (2) year warranty.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 SYSTEM ARCHITECTURE DESCRIPTION**

- .1 All devices supplied under this specification, excluding sensors, shall be connected to the site LAN and shall communicate natively using the following BACnet/IP, BACnet MS/TP, Peer to Peer, or Ethernet (ISO 8802-3), as defined in the ANSI/ASHRAE Standard 135, latest or Peer-to-Peer using Niagara's Fox Protocol or SNMP.
- .2 The network architecture shall consist of multiple levels for communication efficiency:
  - .1 A management level ethernet network based on BACNet IP protocol with other standardized protocols, such as web services, html, JAVA, SOAP, XML, etc. to transmit data to non-BAS software applications and databases. The BAS Server and Operator workstation shall reside on this level of the network.
  - .2 Building level ethernet network based on BACNet IP protocol. This network shall connect the building controllers to the BAS Server and Operator Workstation. Controllers for central plant equipment and large infrastructure shall reside on this network.
  - .3 A floor level network will connect all DDC controlled terminal heating and cooling equipment on a floor or in a system that is controlled by Advanced Application or Application Specific Controllers. Devices on this network shall be connected to a router that connects to the building level ethernet network. A router will be provided for each subnetwork and be capable of handling all of the BACNet interoperability building blocks that are listed for the controllers that reside on the network. This network shall be based on the following communications protocol:
    - .1 **BACNet IP**
- .3 Program data-bases, data acquisition, and all control sequence logic shall reside in the respective controller. Each device shall, to the greatest extent possible, perform its programmed sequence. Operation of each device shall not be dependent on a connection to a server or master controller.
- .4 Mechanical and Electrical Systems i.e., VFD's, chillers, boilers, unitary equipment, etc. units that are equipped with manufacturers furnished controls shall be BTL certified. Gateways are not to be used unless prior written approval has been acquired. A single controller can be used in combination with the manufacturer supplied controls, only where the manufacturer's controls are unable to meet the functional intent.
- .5 The use of multiple application controllers used to control a single piece of equipment is strictly prohibited, except those specifically noted.
- .6 The network shall permit the automatic transferring of all point values from one controller to the other on a planned, prioritized basis. The transfer of point values shall be performed directly between controllers. Systems that relay on a control, network, master or gateway controllers to perform these functions are not acceptable.
- .7 Controller firmware must be flash upgradeable over the network.
- .8 **The Building Controller shall be connected to the owner's VLAN.**

- .9 **Site workstations, otherwise referred to as Caretaker PC, will be provided by the owner as required. This contractor shall facilitate setting up the PC to access the BAS system.**

## **1.2 NETWORK TOPOLOGY**

- .1 Management/Enterprise Level Network
  - .1 A single ethernet connection shall be provided on site for a controller to reside on the owner's VLAN. This controller shall interface to the owner's existing Management Level Network/Enterprise level server.
- .2 Building Level Network
  - .1 Each building level controller shall be provided with a homerun ethernet connection to the building level controller that interfaces to the Management Level Network.
- .3 Floor Level Network
  - .1 BACNet IP Network:
    - .1 Ring Topology shall be used.
  - .2 This contractor shall provide all network infrastructure, switches etc. to enable this topology.
  - .3 BACNet MS/TP Networks: Daisy Chain (BACNet MS/TP may be used only if explicitly permitted elsewhere in this specification).

## **1.3 WIRING RESPONSIBILITY OF THIS CONTRACTOR**

- .1 This contractor is responsible for the following wiring:
  - .1 **All fibre cabling required to implement the ethernet network. (Fiber not likely required for this building).**
  - .2 **All ethernet wiring, switches etc. required to implement the Building Level Network.**
  - .3 **All ethernet wiring, switches, routers etc. required to implement the Floor Level Network(s).**
  - .4 **All BACNet MS/TP wiring required to implement the Floor Level Network(s).** (BACNet MS/TP may be used only if explicitly permitted elsewhere in this specification).
  - .5 All 120V wiring associated with control device power and line voltage control devices, including, but not limited to actuators, line voltage thermostats etc.
  - .6 All low voltage electrical wiring between sensors, starters, etc. and control device input and output wiring as required to provide a complete and operable system.
  - .7 All raceways, boxes, cables, circuit breakers, grounding, relays, motors, starters and wirings from existing panel boards or switchgear through splitters, starters and field disconnect switches to complete power supply required for equipment supplied under this Contract not indicated on the electrical plans and specifications.

- .8 All horizontal copper communications cabling shall be terminated within local IT closet within patch panel. Provide appropriate length patch panel for final termination to owner's network switch.**

**1.4 PERMITS, INSPECTIONS AND TESTING**

- .1 Contractor will arrange for submission to the Electrical Safety Authority (ESA) for review of this project and pay all associated fees. Provide Certificate(s) of Acceptance from ESA and other Authorities having jurisdiction upon completion of the Work.
- .2 Where modification to mechanical or electrical equipment control wiring is necessary to meet the requirements of the specifications, the contractor is responsible for arranging any testing required by the Authority Having Jurisdiction to maintain the required certification and ensure the safe operation of the equipment modified.

**Part 2 Products**

**2.1 GENERAL**

- .1 All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

**2.2 BACnet ETHERNET COMMUNICATION CABLING**

- .1 Data cable shall Category 6 or better Ethernet cable.
- .2 Data cable shall be four twisted pair 24 AWG solid copper, Plenum Rated FT-6 / CMP or Riser Rated FT-4 / CMR (as required by local codes) unshielded twisted cable meeting EIA / TIA 568B.1 Category 5e classification.
- .3 The maximum cable length for each run shall be limited to 90 meters.
- .4 All cables must be Power Sum accepted and recognized by the manufacturer.
- .5 Cable Skew must be specified as 20Ns or less per 100 meters.
- .6 Cables must display the manufacturer's stamp stating that the cable is included in the latest UL verified publication for respective Category standards.
- .7 Cables shall be rated for installation in return air plenums (where allowed in this specification).
- .8 Cables shall be colored to match owner's BAS standard. If owner does not have a standard a different color than the data contractor shall be used.

**2.3 120 VOLT WIRING**

- .1 This contractor is responsible to provide all of their own power wiring, including 120V to transformers. Wiring shall meet the requirements of the Electrical Division specifications.



## **2.4 LOW VOLTAGE AND CONTROL WIRING**

- .1 Minimum #20 AWG stranded copper conductors (larger gauge wire/cable shall be provided where required by BAS equipment and where applications warrant (e.g. rated load, long runs, etc.).
- .2 Wire type used for MSTP, RS-485 twisted pair communications must be balanced twisted pair with 100 to 120 Ohms Characteristic Impedance. The wire shall be less than 30 pF per foot, and preferred 20 AWG or lower. A shield wire shall be included for ground connection.
- .3 All BMS input/output point wire/cable and communication cable shall be shielded.
- .4 Non-shielded cables may be approved for BAS input and output field point wiring following certification from the BAS manufacturer that non-shielded cables will function satisfactorily for the life of the building and that the use of non-shielded cables will not negatively affect other building systems/cabling.
- .5 The manufacturers certification shall guarantee to the Board that should it be determined that BAS system performance is negatively affected or another building system or equipment is negatively affected due to the non-shielded cable, the BAS manufacturer shall replace the cable at no cost to the Board.
- .6 Provide FT-6 rated cable where cable is run free air.

## **2.5 POWER SUPPLIES AND LINE FILTERING**

- .1 Control transformers shall be ULC listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
  - .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 a 150% current overload for at least three seconds without trip-out or failure.
    - .1 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 MIL-STD 810C for shock and vibration.
    - .2 Line voltage units shall be UL recognized and CSA approved.
- .2 Power line filtering.
  - .1 Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component. Surge protection shall have the following at a minimum:
    - .1 Dielectric strength of 1000 volts minimum
    - .2 Response time of 10 nanoseconds or less
    - .3 Transverse mode noise attenuation of 65 dB or greater
    - .4 Common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz.

- .3 Battery Backup with Surge Protection.
  - .1 Provide a battery backup unit with surge protection on the supply to the Supervisory Controller with a minimum capacity of 1000 Volt-amps.

### **Part 3 Execution**

#### **3.1 GENERAL WORKMANSHIP**

- .1 Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- .2 Install wiring in EMT conduit in exposed areas and drops in walls. Comply with all requirements of Electrical Division.
- .3 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- .4 Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).
- .5 Control system wiring and cabling installed for this project shall be performed by professionals in a workmanlike manner and in accordance with National Electric Code (NFPA 70), CSA C22.2 and latest NEMA standards, FCC, and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ).
- .6 All materials must be CSA and NEMA approved. Where this is not possible, arrange and pay for unconditional Electrical Safety Authority approval.
- .7 Follow manufacturer recommendations for installation of all wiring
- .8 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- .9 Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- .10 Free air cabling installed in non-combustible rated buildings shall be fire rated cable with a minimum rating of FT-6.
- .11 Wiring located in combustible rated buildings above T-bar ceiling shall be run in free air using fire rated cable with a minimum rating of FT-6.
- .12 Note: all free air cabling used in combustible rated buildings to interface to security or fire alarm systems shall be FT-6 rated.
- .13 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
- .14 Cables be installed in bundles resting in a cabling support system (J-hooks) where provided by the Electrical Division.

- .15 Cable supports shall be attached to the wall or ceiling of the area they are running through. Cable supports shall not be attached to:
  - .1 Electrical raceways,
  - .2 Duct work,
  - .3 Ceiling suspension systems,
  - .4 Piping,
  - .5 Wilson joists.
  - .6 All wire/cable terminations shall be made at screw type terminal strips. Wire nut terminations and butt splices shall not be acceptable. Wiring runs shall be continuous runs without splices.
- .16 All BAS equipment and components shall be grounded to building ground facilities.
- .17 BAS shall only be capable of controlling electric motors when the associated hand/off/auto (HOA) motor control switches are in the "auto" position. BAS control shall be wired into the auto circuit of the hand/off/auto motor control circuit only. Where hand/off/auto switches do not exist they shall be provided by the Controls Contractor.
- .18 Life safety and equipment protection interlocks shall be wired to override equipment whenever it is in operation.
- .19 Existing interlocks and override control should typically not be removed or overridden by the application of new BAS control without the specific instruction and/or approval of the Owner.
- .20 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- .21 Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).
- .22 Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- .23 Adhere to this specification's Electrical Division requirements where raceway crosses building expansion joints.
- .24 Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
- .25 Size of raceway and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- .26 All wiring in mechanical, electrical, or service rooms-or where subject to mechanical damage- shall be installed in raceway at levels below 3 m (loft).
- .27 Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- .28 Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

### **3.2 ETHERNET WIRING**

- .1 Cabling shall be installed as continuous links, including shielding. Field splices are strictly prohibited.
- .2 Network installation shall strictly adhere to the manufacturer's network installation instructions and procedures.
- .3 Data cabling shall be run separately from power and signal wiring
- .4 Network installation shall conform to standards for the LAN types and cabling types selected. Specific network rules inherent to the ANSI/AHRAE Standard 135, latest will be followed. Those include but are not limited to:
  - .1 The maximum length and cabling type of an MS/TP segment shall be in accordance with manufacturers specifications and shall comply with EIA-485.
  - .2 Each internetwork LAN must have a unique Network Number (1 - 65,545).
  - .3 The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard.
- .5 Primary LAN Network wire and cable shall be run separately from all other wiring.
- .6 Other LAN Network wire and cabling shall be installed separate from any wiring over thirty (30) volts.
- .7 All communications shielding shall be grounded as per Networked System manufacturer's recommendations.

### **3.3 120 VOLT WIRING**

- .1 All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway according to NEC and the Electrical Division requirements.
- .2 Power wiring for all enclosures and equipment, including branch circuit wiring from circuit breaker panels shall be the responsibility of the System Contractor unless specifically shown on the Plans or Specifications.
- .3 The Building Controller panel shall be served from isolated ground receptacle via UPS by dedicated branch circuits.
- .4 Power shall NOT be obtained by tapping into miscellaneous circuit that could inadvertently be switched off.
- .5 Power for controls equipment shall be from a dedicated circuit. Where a controller is dedicated to controlling a single piece of equipment, power may be obtained directly from that equipment.
- .6 All other enclosures, sensor and control devices shall be fed from separate circuits in the electrical distribution panels and shall not be served from the typical floor receptacle or lighting circuits.

### **3.4 LOW-VOLTAGE ELECTRICAL AND CONTROL WIRING**

- .1 All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.)

- .2 Cabling shall be installed as continuous links, including shielding. Field splices are strictly prohibited.
- .3 Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- .4 All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- .5 Maximum allowable voltage for control wiring shall be 120-volts.

### **3.5 POWER CONDITIONING**

- .1 Provide integral or supplementary power conditioning equipment for all BAS hardware so as to ensure that power line noise or electrical spikes, noise, bursts, sags or surges shall not damage equipment or software or cause erroneous computations.

### **3.6 IDENTIFICATION OF HARDWARE AND WIRING**

- .1 All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.
- .2 The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- .3 Permanently label or code each point of field terminal strips to show the instrument or item served.
- .4 Identify control panels with minimum 1 cm (1/2 in.) letters on laminated plastic nameplates.
- .5 Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
- .6 Identify room sensors relating to terminal box or valves with nameplates.
- .7 Manufacturers' nameplates and UL or CSA labels are to be visible and legible after equipment is installed.
- .8 Identifiers shall match as-built documents.
- .9 Ethernet cabling shall be a separate color than the building data cabling and be labelled as BUILDING AUTOMATION SYSTEM at 20 foot intervals.

**END OF SECTION**

**Part 1            General**

**Not Used**

**Part 2            Products**

**2.1                ACCEPTABLE MANUFACTURER**

- .1        Operator software shall be matched to the Building Automation System supplier.

**2.2                BUILDING AUTOMATION SYSTEM SERVER AND OPERATOR WORKSTATION  
HARDWARE**

- .1        The owner shall provide the operator workstation. Software shall be compatible with 64 bit Windows operating systems.
- .2        Install all software necessary to permit the operator to create, modify, delete, file and recall all graphics. The package shall encompass all graphics, control, control schematics and wiring details for all points and systems contained in the Input/output Point Summary. Provide a separate, valid license, complete with manuals, disks, and documentation for the graphics engineering software. Provide a separate valid license for of the software necessary to view the graphics with each Operator Workstation,
- .3        Set up an icon on the desktop to take the Owner directly to the BAS system login page.
- .4        Provide a copy of the software (or all software's if there are multiple) used to program and download sequences to controllers.
- .5        Provide a backup of the all of the programs used in the system for storage by the Owner.

**2.3                OPERATOR WORKSTATION SOFTWARE - GENERAL**

- .1        Provide a graphical user interface that shall minimize the use of keyboard through the use of a mouse or similar pointing device, with a "point and click" approach to menu selection and a "drag and drop" approach to inter-application navigation.
- .2        Operator workstation interface software shall minimize operator training through the use of user-friendly and interactive graphical applications, 30-character English language point identification, on-line help, and industry standard Windows application software.
- .3        Interface software shall simultaneously communicate with and share data between any combination of dedicated, modem autodial, and Ethernet-connected building level networks. The software shall provide, as a minimum, the following functionality:
  - .1        Real-time graphical viewing and control of the BAS environment.
  - .2        Reporting of real time and historical information.
  - .3        Scheduling and override of building operations.
  - .4        Collection and analysis of historical data.

- .5 Point database editing, storage, and downloading of controller databases. The editor shall allow the user to create, view existing, modify, copy, and delete points from the database. The point editor shall also allow the user to configure the alarm management strategy for each point. The editor shall provide the option for editing the point database in an online or offline mode with the DDC Controllers.
- .6 The workstation software shall also provide the capability to perform bulk modification of point definition attributes to a single or multiple user-selected points. This function shall allow the user to choose the properties to copy from a selected point to another point or set of points. The selectable attributes shall include, but are not limited to, Alarm management definitions and Trend definitions.
- .7 Utility for combining points into logical Point Groups. The Point Groups shall then be manipulated in Graphics, trend graphs and reports in order to streamline the navigation and usability of the system.
- .8 Alarm reporting, routing, messaging, and acknowledgment.
- .9 “Collapsible tree,” dynamic system architecture diagram application:
  - .1 Showing the real-time status and definition details of all workstations and devices on an enterprise level network.
  - .2 Showing the real-time status and definition details of all DDC and HVAC Mechanical Controllers at the building level.
  - .3 Showing the status and definition details of all field-level application controllers.
- .10 Definition and construction of dynamic colour graphic displays.
- .11 Online, context-sensitive help, including an index, glossary of terms, and the capability to search help via keyword or phrase.
- .12 On-screen access to User Documentation, via online help or PDF-format electronic file.
- .13 Automatic and manual database backup at the workstation for database changes initiated at DDC Controller operator interface terminals.
  - .1 Backups shall produce a configuration file that contains pertinent details regarding the specific backup. This log file shall be created each time a backup is run and be stored in the backup directory.
  - .2 Restore dialog box shall list detailed information to facilitate the restore of the correct database.
  - .3 Ability to restore selected components of a backup.
  - .4 Delete old backup directories automatically or individually from a detailed list.
- .14 Provide automatic backup and restore of all DDC controller and HVAC Mechanical Equipment controller databases on the workstation hard disk.
- .15 Display dynamic trend data graphical plot.
  - .1 Must be able to run multiple plots simultaneously.
  - .2 Each plot must be capable of supporting 10 pts/plot minimum.

- .3 Must be able to plot both real-time and historical trend data.
- .4 Must be able to plot real time data without prior configuration.
- .16 Program editing.
- .17 Transfer trend data to 3rd party spreadsheet software.
- .18 Scheduling reports.
- .19 Operator Activity Log.
- .20 Open communications via BACnet Client & Server option.
- .21 Tracking of supervised objects.
- .22 A colour graphics application to build and edit graphics.
- .23 Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via adjustable user-sized windows. Operator shall be able to drag and drop information between the following applications, reducing the number of steps to perform a desired function (e.g., Click on a point on the alarm screen and drag it to the dynamic trend graph application to initiate a dynamic trend on the desired point):
  - .1 Dynamic colour graphics application.
  - .2 Alarm management application.
  - .3 Scheduling application.
  - .4 Dynamic trend graph data plotter application.
  - .5 Dynamic system architecture diagram application.
  - .6 Control Program and Point database editing applications.
  - .7 Reporting applications.
  - .8 Report and alarm printing shall be accomplished via Windows Print Manager, allowing use of network printers.
- .4 Standard Windows applications shall run simultaneously with the BAS software. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BAS alarms and monitoring information

## **2.4 CLIENT SERVER CONNECTIVITY**

- .1 Client sessions must be allowed to run on the server and on other devices connected to the server via Intranet, Extranet, or Internet connections.
- .2 Internet connections, ISP services, as well as necessary firewalls or proxy servers shall be provided by the owner as required to support remote access features.
- .3 The following client options must be supported:
  - .1 Installed Client.
    - .1 Software application installed from installation media on to the client machine.



- .2 Installed client software must be configurable to allow it to run in a Closed Mode such that the BAS software can lock down the client machine and prevent users without permission from minimizing the application or running other Windows applications that might cover the BAS software interface.
- .3 Communication between the server and Installed Clients must be monitored so that any break in communication between the server and an installed client results in notification at the Server and Installed Client machine
- .4 Installed client machines communicate directly with the BAS server.
- .2 Web Client.
  - .1 Software that runs in a browser on the client machine as a Full Trust client application.
  - .2 Connected to the BAS software server via Microsoft IIS Server.
- .3 Windows App.
  - .1 Software application downloaded from the BAS server to run on the client machine like an installed application.
  - .2 Application must be automatically updated whenever new apps are available at the server.
  - .3 Connected to the BAS software server via Microsoft IIS Server.
- .4 Each of the client options shall provide the same functionalities including operation and configuration capabilities.

## **2.5 CERTIFICATIONS AND APPROVALS**

- .1 BAS software shall have been tested against the following norms and standards:
  - .1 BACnet Revision 1.13, certified by BACnet Testing Laboratory as BACnet Advanced Workstation Software (BTL B-AWS).
  - .2 IT security compliant with the ISA-99/IEC 62443 Security Level: SL1.
  - .3 OPC DA V2.05a and V3.0 Server, certified by the OPC Foundation certification program.
  - .4 UL-listed to UL864 9th edition Standard for Control Units and Accessories (when installed on a UL-approved computer).

## **2.6 ACCESS RIGHTS AND USER PRIVILEGES**

- .1 Operator-specific password access protection shall be provided to allow the administrator/manager to limit users' workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported). The administrator/manager shall be able to grant discrete levels of access and privileges, per user, for each point, graphic, report, schedule, and BAS workstation application. And each BAS workstation user account shall use a Windows user account as a foundation.

- .2 The workstation software shall also include an application to track the actions of each individual operator, such as alarm acknowledgement, point commanding, schedule overriding, database editing, and logon/logoff. The application shall list each of the actions in a tabular format and shall have sorting capabilities based on parameters such as ascending or descending time of the action, or name of the object on which the action was performed. The application shall also allow querying based on object name, operator, action, or time range.

## **2.7 WORKSTATION APPLICATION EDITORS**

- .1 Each PC system shall support editing of all system applications. Provide editors for each application at the workstation. The applications shall be downloaded and executed at one or more of the controller panels.
  - .1 Colour Graphics Application. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.
  - .2 Scheduling Application. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and month. This shall consist of a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The start and stop times for each object shall be adjustable from this master schedule. Schedules shall be easy to copy to other objects and/or dates.
  - .3 Custom Application Programming Application: Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded.

## **2.8 DYNAMIC COLOUR GRAPHICS APPLICATION**

- .1 Must include graphic editing and modifying capabilities.
- .2 Graphics shall be available with the same look and functionality whether they are displayed at an installed client workstation or via browser interface.
- .3 User shall be able to add/delete/modify system graphics for floor plan displays and system schematics for each piece of mechanical equipment from the standard user interface without need for specialized tools.
- .4 Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.
- .5 A library of standard control application graphics and symbols must be included. A library of minimum 400 symbols will be provided consisting of common systems, including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams, piping and laboratory symbols.

- .6 In the development of a graphic picture, the graphics software shall support all operator actions necessary to:
  - .1 Define the background;
  - .2 Establish colours;
  - .3 Locate, orient and size the symbols;
  - .4 Position and edit alphanumeric descriptors;
  - .5 Establish connecting lines;
  - .6 Establish sources of real time data and location of their readouts.
- .7 The Graphics application shall include a set of standard Terminal Equipment controller application-specific background graphic templates. Templates shall provide the automatic display of a selected Terminal Equipment controller's control values and parameters, without the need to create separate and individual graphic files for each controller.
- .8 The Graphics application shall be capable of automatically assigning the appropriate symbol for an object (point) selected to be displayed on the graphic based on what the object represents (fan, duct sensor, damper, etc.) when the object is placed on a graphic. The user shall be able to override the assigned symbol if desired.
- .9 User shall be able to add custom symbols to the symbol library.
- .10 Software shall permit the importing of AutoCAD or scanned pictures for use in graphics.
- .11 Must be able to command points directly off graphics application.
- .12 Graphic display shall include the ability to depict real-time point values dynamically with animation, picture/frame control, symbol association, or dynamic informational text-blocks. At a minimum animation shall reflect, ON or OFF conditions, and shall also be optionally configurable for up to five rates of animation speed. Animation shall also indicate the priority and alarm status of the point.
- .13 Animation status indicators shall give you a quick visual indication of a point's value, priority, or status in the form of an icon.
- .14 Software shall provide animation that depicts movement of mechanical equipment, or air or fluid flow.
- .15 Navigation through various graphic screens shall be optionally achieved through a hierarchical "tree" structure or view recently opened graphics through a backward and forward paging.
- .16 Graphics viewing shall include dynamic pan and zoom capabilities.
- .17 Graphics viewing shall include the ability to switch between multiple layers with different information on each layer.
- .18 Graphics shall include a decluttering capability that allows layers to be programmatically hidden and displayed based on zoom level.
- .19 The software must provide the ability to create dashboard views consisting of gauges and charts that graphically display system and/or energy performance.

- .20 Advanced linking within the Graphics application shall provide the ability to navigate to outside documents (e.g., .doc, .pdf, .xls, etc.), Internet web addresses, e-mail, external programs, and other workstation applications, directly from the Graphics application window with a mouse-click on a customizable link symbol.
- .21 Colours shall be used to indicate status and change as the status of the equipment changes. The state colours shall be user definable.
- .22 The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, point alarm association, or text-based commands.

## 2.9 REPORTS

- .1 Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archivable on the hard disk for historical reporting. Provide the ability for the operator to obtain real-time logs of all objects by type or status (e.g., alarm, lockout, normal). Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications, including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer and shall be set to be printed either on operator command or at a specific time each day.
- .2 Provide ability for the owner to readily customize these reports:
  - .1 All Objects: All system (or subsystem) objects and their current values.
  - .2 Alarm Summary: All current alarms (except those in alarm lockout).
  - .3 Disabled Objects: All objects that are disabled.
  - .4 Alarm Lockout Objects: All objects in alarm lockout (whether manual or automatic).
  - .5 Alarm Lockout Objects in Alarm: All objects in alarm lockout that are currently in alarm.
  - .6 Logs:
    - .1 Alarm History
    - .2 System Messages
    - .3 System Events
    - .4 Trends
- .3 Custom Reports. Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.
- .4 Override Reports. Provide a monthly report showing the daily total time in hours that each system has requested after-hours HVAC and lighting services. Provide an annual summary report that shows the override usage on a monthly basis.

- .5 Reports shall be generated on demand or via pre-defined schedule, and directed to displays, printers, or file. As a minimum, the system shall allow the user to easily obtain the following types of reports:
  - .1 A general listing of all or selected points in the network.
  - .2 A status report showing present value and alarm status.
  - .3 List of all points currently in alarm.
  - .4 List of all points currently in override status.
  - .5 List of all disabled points.
  - .6 List of all points currently locked out.
  - .7 List of user accounts and access levels.
  - .8 List all weekly schedules and events.
  - .9 List of holiday programming.
  - .10 List of control limits and dead bands.
  - .11 Custom reports from 3rd party software.
  - .12 System diagnostic reports including, list of DDC panels on line and communicating, status of all DDC terminal unit device points.
  - .13 List of programs.
  - .14 List of point definitions.
  - .15 List of logical point groups.
  - .16 List of alarm strategy definitions.
  - .17 List of DDC Control panels.
  - .18 Point totalization report.
  - .19 Point Trend data listings.
  - .20 Initial Values report.
  - .21 User activity report.

## **2.10 SCHEDULING AND OVERRIDE**

- .1 The software shall provide a calendar type format for simplification of time and date scheduling and overrides of building operations.
- .2 The software shall support the definition of BACnet schedules that are defined at the workstation and are downloaded to Building Controller to ensure time equipment scheduling when PC is off-line, such that the operating software is not required to execute time scheduling. The software must provide the following capabilities for BACnet scheduling capabilities as a minimum:
  - .1 Fully support all BACnet Schedule, Calendar, and Command objects.
  - .2 Daily and Weekly schedules.
  - .3 Ability to combine multiple points into a logical Command Groups for ease of scheduling (e.g., all Building 1 lights).
  - .4 Ability to schedule for a minimum of up to ten (10) years in advance.

- .3 The software shall support the definition of schedules that are configured and executed to run at the workstation, to support scheduling of workstation software activities and to support field systems that do not include internal scheduling mechanisms. The software must provide the following capabilities for BACnet scheduling capabilities as a minimum:
  - .1 Schedule predefined reports.
  - .2 Schedule Trend collections.
  - .3 Schedule automated system backups.
  - .4 Schedule commands to be sent to field panels.
  - .5 Daily and weekly schedules.
  - .6 Setting up and executing Holiday schedules.
  - .7 Ability to combine multiple points into a logical Command Groups for ease of scheduling (e.g., all Building 1 lights).
  - .8 Ability to schedule for a minimum of up to ten (10) years in advance.
- .4 The software shall support the definition of Schedules Objects that are defined at the workstation and are downloaded to Building Controller to ensure time equipment scheduling when PC is off-line, such that the operating software is not required to execute time scheduling The software must provide the following capabilities for BACnet scheduling capabilities as a minimum:
  - .1 Equipment schedule Zones.
  - .2 Equipment schedule Events.
  - .3 Configuration of Daily, Weekly, Monthly schedules.
  - .4 Configuration of Replacement Days.
- .5 The software shall provide the ability for users to override regular weekly schedules through menu selection, graphical mouse action or function key.
- .6 The software shall provide a timeline view, showing the results of any number of combined selected workstation and field panel controller schedules for an overview of facility operation.
- .7 Additionally, the scheduling application shall:
  - .1 Provide filtering capabilities of schedules, based on name, time, frequency, and schedule type (event, zone, report).
  - .2 Provide sorting capabilities of schedules, based on name, time and type of schedule (zone, event, report).
  - .3 Provide searching capabilities of schedules based on name – with wildcarding options.

## **2.11 COLLECTION AND ANALYSIS OF HISTORICAL DATA**

- .1 Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals (up to four time-based definitions per point) or change of value, both of which shall be user-definable. Trend data shall be collected stored on hard disk for future diagnostics and reporting. Automatic Trend collection may be scheduled at regular intervals through the same scheduling interface as used for scheduling of zones, events, and reports. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.
- .2 The software must support configuration of panels that have a trending level threshold, above which the data will be automatically uploaded to the BMS server to prevent overwriting the data in the field panel. The trending level will be user defined in % of available space (e.g., automatically upload when the trend buffer is at 75% of allocated space).
- .3 The entire collection process shall be automated so that the data collection definition, amount of data to be collected, collection report and scheduling take the form a wizard, or online assist utility, in order to complete this process within a small amount of time for a large group of points.
- .4 Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of selected points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. DDC contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times, equipment efficiency, and/or building environmental conditions. DDC contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.
- .5 Provide additional functionality that allows the user to view real-time trend data on trend graphical plot displays. A minimum of fifteen points may be plotted, of either real-time or historical data. The dynamic graphs shall continuously update point values. At any time, the user may redefine sampling times or range scales for any point. In addition, the user may pause the graph and take "snapshots" of plot screens to be stored on the workstation disk for future recall and analysis. Exact point values may be viewed and the graphs may be printed. A minimum of 8 true graphs shall run simultaneously. Operator shall be able to command points directly on the trend plot by double clicking on the point. Operator shall be able to zoom in on a specific time range within a plot. Operator must be able to configure separate left and right axis for easier differentiation of point values and be able to display historical data for the same group of points at different times simultaneously for easy comparison of system behaviour over time. The dynamic trend plotting application shall support the following types of graphs, with option to graph in 3D: line graph, area graph, curve graph, area-curve graph, step graph, and scatter graph. Each graph may be customized by the user, for graph type, graph text, titles, line styles and weight, colours, and configurable x- and y-axes.

## **2.12 ALARM MANAGEMENT**

- .1 Alarm Routing shall allow the user to send alarm notification to selected printers or workstation location(s) based on time of day, alarm severity, or point type.
- .2 Alarm Notification shall be presented to each workstation in a tabular format application, and shall include the following information for each alarm point: name, value, alarm time & date, alarm status, priority, acknowledgement information, and alarm count. Each alarm point or priority shall have the ability to sound a discrete audible notification.
- .3 Only events for which the logged on user has privileges to view shall be displayed on each workstation.
- .4 The software shall provide the ability to users to limit the list of events displayed at each workstation, no matter who is logged on (i.e. workstation will only show fire events).
- .5 Each event shall have the ability to sound an audible notification based on the category of the event.
- .6 Alarm Display shall have the ability to list & sort the alarms based on alarm status, point name, ascending or descending alarm time.
- .7 Directly from the Alarm Display, the user shall have the ability to acknowledge, silence the alarm sound, print, or erase each alarm. The interface shall also have the option to inhibit the erasing of active acknowledged alarms, until they have returned to normal status. The user shall also have the ability to command, launch an associated graphic or trended graphical plot, or run a report on a selected alarm point directly on the Alarm Display.
- .8 Each alarm point shall have a direct link from the Alarm Display to further user-defined point informational data. The user shall have the ability to also associate real-time electronic annotations or notes to each alarm, which can be viewed from the alarm display screen, graphic display screen, and anytime the point is being commanded to a new value or state.
- .9 Alarm messages shall be customizable for each point, or each alarm priority level, to display detailed instructions to the user regarding actions to take in the event of an alarm. Alarm messages shall also have the optional ability to individually enunciate on the workstation display via a separate pop-up window, automatically being generated as the associated alarm condition occurs.
- .10 Software shall provide the option to configure detailed operating procedures that guide a user through predetermined standard operating procedures for handling critical events. Users shall be able to log completion of each operating step as it is performed.
- .11 Alarm Display application shall allow workstation operators to send and receive real-time messages to each other, for purposes of coordinating Alarm and BAS system management.



- .12 Remote notification of messages
  - .1 Workstation shall be configured to send out messages to numeric pagers, alphanumeric pagers, phones (via text to speech technology), SMS (Simple Messaging Service, text messaging) Devices, and email accounts based on a point's alarm condition. A point's alarm status will be configurable for remote notification whether the point is in a specific alarm priority, has returned to normal, failed, out of service, in trouble, alarm disabled by program or operator and alarm by command.
  - .2 There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices, which can receive messages from the system.
  - .3 On a per point basis, system shall be configurable to send messages to an individual or group and shall be configurable to send different messages to different remote devices based on alarm message priority level.
  - .4 Remote devices may be scheduled as to when they receive messages from the system to account for operators' work schedules.
  - .5 System must be configurable to send messages to an escalation list so that if the first device does not respond, the message is sent on to the next device after a configurable time has elapsed.
  - .6 Message detail shall be configurable on a per user basis.
  - .7 During a mass influx of alarms, remote notification messages shall have the ability to optimize several alarms into an individual remote notification message.
  - .8 Workstation shall have the ability to send manual messages allowing an operator to type in a message to be sent immediately.
  - .9 Workstation shall have a feature to send a heartbeat message to periodically notify users that they have communication with the system.
  - .10 Ability to configure Fire and Life Safety points for remote notification through the point editor application.
- .13 Expanded Alarm Issue Management
  - .1 As optional functionality, configurable point-by-point, the system shall impose an ordered process for managing the lifecycle of an alarm. The process requires the operator to:
    - .1 Acknowledge the alarm.
    - .2 Assign the alarm issue to a contact (e.g., tradesperson or trained staff).
    - .3 Answer – an explanation of the diagnosis or solution to the alarm.
    - .4 Resolve – this happens when at least one Answer is provided and the point has returned to a stable Normal state.
    - .5 Clear – the operator may clear the alarm issue from the display.
  - .2 Each step in the lifecycle is automatically recorded for audit trail historical purposes.
- .14 Provide alarm priority functionality to meet requirements of sequences of operation.

## **2.13 AUDIT TRAIL OF USER ACTIONS**

- .1 To protect against inadvertent changes damaging critical system functions, and to enable audit-trail tracking on selected database objects, optional functionality shall be provided to configure selected objects for increased supervision. The additional supervision functionality shall allow for designation of points, control programs, trend collection reports, panels on a building level network and user account objects for detailed tracking of user modifications and deletions. Display an icon, which indicates the level of supervision for an object within specified applications.
  - .1 The minimal setting for additional supervision shall warn the user that he is attempting to modify or delete a supervised object and will require the user to input a reason-for-change in order to proceed. The warning shall be customizable for each object.
  - .2 Additional supervision levels shall be optional to require the user to re-enter his user password, and/or require that a “supervisor” enter his user password, in order to proceed with the modification or deletion of the supervised object.
  - .3 Supervised objects shall be assigned a dedicated “revision number,” and the revision number shall be incremented automatically by the system upon each user modification. This revision number may serve as a method for tracking changes to objects.
  - .4 Point in an alarm state can have annotations added which can be viewed from the alarm display screen, graphic display screen, and anytime the point is being commanded to a new value or state. For supervised objects, the point annotation will automatically populate the reason for change field.
- .2 Audit Trail tracking of supervised objects shall record the following:
  - .1 The property of the object that was changed.
  - .2 The value of the property before the change.
  - .3 The value of the property after the change.
  - .4 Who made the change.
  - .5 The reason for change (entered by the operator).
  - .6 Who the change was authorized by (if configured for this level of supervision).

## **2.14 EXTERNAL DATA ACCESS**

- .1 The software shall provide the ability to expose configuration properties and real-time values through CSV files, OPC DA, OPC UA, or REST-based Web Services.
- .2 The software shall provide the ability for external applications to change configuration and real-time values through OPC DA, OPC UA, or REST-based Web Services.
- .3 The software shall provide the ability for external applications to access historical Trend data through CSV files or REST-based Web Services.
- .4 External data access must be secured using the level of permissions configured for users and operator workstations.

- .5 Web service interfaces must allow for exchanging data (object's values, events and trend series) between workstation and external applications such as facility management systems, enterprise applications, mobile applications or other value-added services.
- .6 Documentation describing web services interfaces must be included to allow external developers to write applications that leverage the data exchange.

## **2.15 DATA SECURITY**

- .1 Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the functions accessible to viewing and/or changing each system application, editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time period shall be user-adjustable. All system security data shall be stored in an encrypted format.
- .2 The BAS software must allow that all communication paths between clients and the server are encrypted and protected against replay attacks as well as data manipulation.
- .3 Any runtime data transfer between the system server and Web Server (IIS) must be allowed to be encrypted by Desigo CC.
- .4 Communication between any Web Server (IIS) and the Web Clients must be allowed to be encrypted.
- .5 Passwords must be handled with encrypted storage and transmission
- .6 The software must support the use of public domain algorithms for cryptographic functions, including AES, DiffieHellmann, RSA, and SHA-2. No self-coded algorithms shall be allowed.
- .7 All symmetrical encryption must use 256 bit AES or stronger.
- .8 All asymmetrical encryption must use 2048 bit or stronger.
- .9 The software must support the use of commercial certificates for securing client-server communications.
- .10 The software must support the use of self-signed certificates to allow local deployments without the overhead of obtaining commercial certificates.
- .11 The BAS software shall be compatible with the following Virus Scanners:
  - .1 Kaspersky.
  - .2 Avira.
  - .3 McAfee.
  - .4 Bitdefender.
  - .5 TrendMicro Office Scan.

## **2.16 SUBSYSTEM CONNECTIVITY**

- .1 The BAS application software must be capable of connecting simultaneously to multiple control systems and data sources.
- .2 Interface software shall simultaneously communicate with and share data between multiple Ethernet-connected building level networks.
- .3 The BAS application software must support the following standard protocols:
  - .1 BACnet IP (standard Revision 1.13).
  - .2 OPC (OLE for Process Control) OPC DA 2.05, 3.0.
  - .3 Modbus TCP.
  - .4 SNMP (Agent V1 and V2).
- .4 Any break in system controller communication must result in a notification at the server.

## **2.17 BACnet INTEROPERABILITY**

- .1 The Operator Workstation Software shall be capable of BACnet IP communications.
- .2 The Operator Workstation Software shall have demonstrated interoperability during at least one BTL Interoperability Workshop.
- .3 The Operator Workstation Software shall have demonstrated compliance to BTL B-AWS device classification through BTL listing as specified in ANSI/ASHRAE 135 under revision 1.13 or higher.
- .4 The BAS software shall meet the BACnet device profile of an Advanced Workstation Server (B-AWS) and Operator Workstation (B-OWS) and shall support all BACnet BIBBs required to deliver a full and operable system.
- .5 The BAS Server and Workstations shall support the following Data Link Layers:
  - .1 BACnet IP Annex J.
  - .2 BACnet IP Annex J Foreign Device.
  - .3 ISO 8802-3, Ethernet (Clause 7).
- .6 The BAS Server and Workstations shall be able to interact with all of the BACnet objects in the controllers. In addition, the software shall be able to support the following objects as they relate to features in the workstation software:
  - .1 Calendar – Creatable, Deletable.
  - .2 Command – Creatable, Deletable.
  - .3 Event Enrollment – Creatable, Deletable.
  - .4 Notification Class – Creatable, Deletable.
  - .5 Schedule - Creatable, Deletable.
- .7 The BAS Server and Workstations shall support transmitting and receiving segmented messages.
- .8 The BAS Server and Workstation shall have the capability to be the BACnet/IP Broadcast Management Device (BBMD) and support foreign devices.

**Part 3            Execution**

**3.1                GRAPHICS**

- .1 Provide linked graphic pictures as follows:
  - .1 Building Identification front plate with menu.
  - .2 Photo of front elevation of building.
  - .3 Floor Plan of each building level.
  - .4 Schematic for each system.
  - .5 Tables summarizing temperatures in each zone.
  - .6 Tables summarizing the monitored functions off all air handling units.
  - .7 Table summarizing weekly schedules.
  - .8 Tables summarizing fault detection results.
  - .9 Outside Lighting Schematic.
  - .10 Time of Day schedules.
  - .11 Up to five additional graphics as defined by the owner.
  - .12 Global Setpoints, summarizing items such as Min/Max Setpoints, Override Period, etc.
  - .13 Global Statistics, summarizing lowest temp, highest temp, number of heat pumps heating/cooling, number of zones occupied, number of zones in override, etc.
  - .14 The graphics shall be submitted to the Owner for preapproval before final implementation.
- .2 Graphic Display Screens
  - .1 Individual schematics shall include, where applicable:
    - .1 Navigation buttons to each major system in the building which indicate current screen display by a change in button colour.
    - .2 Outdoor air temperature shall be displayed on every graphic screen.
    - .3 Access links to all global schedules or specific screens affecting entire building operation.
    - .4 Access buttons links to Set Time, Holiday Schedule, Alarms, Points on Manual, Conversion °C - °F, 24 Hour Clock, Operations Manual, Autocad Drawings, BAS Manual, and Work Orders
    - .5 Status of monitored and controlled on/off points;
    - .6 Current value of analog input;
    - .7 Identification for each point;
    - .8 Current value of the setpoint & DDC output for each control loop;
    - .9 Current state of each control loop (computer auto/computer manual);
    - .10 Schematic and systems identification;
    - .11 Point alarm lock-out status;
    - .12 Equipment symbolic information (pump, fan, etc);
    - .13 Alarm/normal indication

- .14 All points pertinent to one system shall be on one screen.
- .15 Symbols shall have the ability to change colour, depending on the status.
- .16 Animations are to indicate point status. Animations are to include pumps, fans and boilers. The BMS contractor shall obtain from the owner the final numbering and name convention to be used for all spaces in the building for incorporation in the “As Built” drawings and manuals.
- .2 System Architecture.
  - .1 Control panel layout and network architecture.
  - .2 Indicating BAS panels and panel type (model).
  - .3 Panel locations room number text on screen.
  - .4 Systems controlled by each panel.
  - .5 Links to points list accessible from each panel.
- .3 Architecture Panel Layout (Locations on Floor Plans)
  - .1 Locations of each panel on each floor plan level.
  - .2 Panel types indicated by different icon.
  - .3 Controls transformers locations.
  - .4 Main network wiring and sub-network wiring layout.
- .4 Floor Plans Graphics
  - .1 Room numbers accurate as per room signage.
  - .2 Mechanical rooms locations and signage tags.
  - .3 space temperatures for every temperature on each floor in appropriate room.
  - .4 space focus pick area for individual room control where applicable shall be yellow text.
  - .5 Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour.
  - .6 Status of Air Handler by colour change Red for off status, or text indication.
  - .7 Supply air temperature for each air handler.
- .5 HVAC/AHU Unit Graphic
  - .1 Accurate representation of the HVAC design.
  - .2 All associated control points to be displayed.
  - .3 A calculated percentage of fresh air shall be indicated on the HVAC graphic.
  - .4 A calculated outdoor airflow rate and exhaust airflow rate shall be indicated on the H/ERV graphic. Graphic shall also indicate low/med/high speed and occupied/unoccupied setting, and economizer position (recovery mode or full bypass).

- .5 Operator offset adjustment of the supply air setpoint, adjustable directly from the graphic.
- .6 HVAC physical location shall be indicated on the graphic.
- .7 Weekly occupied time of day schedule for the associated HVAC shall be accessible directly from the graphic by selecting an icon.
- .8 Trend logs shall be accessible directly from the graphic by selecting an icon.
- .6 Exhaust Fans Graphic
  - .1 Exhaust fans control shall be editable directly from the graphic.
  - .2 Exhaust fan status shall be indicated in text and a change in the exhaust fan icon.
  - .3 Exhaust fan physical location shall be indicated on the graphic.
  - .4 Area of the building being exhausted shall be indicated on the graphic.
- .7 Boiler and Air Source Heat Pump Plants
  - .1 Accurate representation of piping design and layout.
  - .2 All associated control points to be displayed.
  - .3 Temperature reset curve to be displayed, along with calculated value.
  - .4 Operator shall be able to adjust set point from the graphic.
  - .5 Physical location of the plant equipment shall be indicated.
  - .6 All piping loops shall be labelled.
  - .7 Weekly occupied time of day schedule for the associated HVAC shall be accessible directly from the graphic by selecting an icon.
  - .8 Trend logs shall be accessible directly from the graphic by selecting an icon.
- .8 Terminal Units/Misc. Items
  - .1 Accurate representation of equipment.
  - .2 All associated control points to be displayed.
  - .3 Space temperature.
  - .4 Mode of operation.
  - .5 Current setpoint.
  - .6 Trend logs shall be accessible directly from the graphic by selecting an icon.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED SECTIONS**

- .1        This section is to be read in conjunction with the remainder of the Division 25 specifications.

**Part 2            Products**

**2.1            ACCEPTABLE MANUFACTURERS**

- .1        Controller shall be matched to the Building Automation System supplier.

**2.2            GENERAL REQUIREMENTS**

- .1        Provide BACNet controllers. DDC controllers that are not BACnet compliant shall not be acceptable under this specification and are strictly prohibited.
- .2        All BAS DDC Devices at all levels shall be fully custom-programmable in the field using the standard Operators Workstation Software. No configurable, canned program application specific controllers will be permitted unless specifically noted in this specification.
- .3        All BAS controllers shall be tested, certified, clearly stamped and listed by the BACnet Testing Laboratories (BTL)
- .4        The BACnet operating stack must be embedded directly in every Device at the board level, and in all operator interface software packages.
- .5        No Gateways, Communication Bridges, Protocol Translators or any other device that translates any proprietary or other communication protocol to the BACnet communication protocol shall be permitted as a part of the BAS installation pursuant with this specification section. Gateways may only be used as required for communication to existing systems or systems installed pursuant with other specification sections.
- .6        Program database, data acquisition, and all control sequence logic shall reside in each DDC Device. The Building Level Network shall not be dependent upon connection to a Server or Master Controller for performance of the Sequence of Operation. Each individual Device shall, to the greatest possible extent, perform its programmed sequence without reliance on the Building Level Network.
- .7        All BAS DDC Devices shall be capable of updating firmware using software via internetwork without replacing any hardware, microprocessors or chips.
- .8        All binary output points shall be protected from short cycling via output configuration and/or programming. This feature shall allow minimum on time and off-time to be configurable.



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- .9 Panels shall use only following signal types to interface with field data points:
- .1 Binary Input (BI) also known as Digital Input (DI) contacts. Internal voltage source shall be dry contact or 0-5 V.D.C.
  - .2 Analogue Input (AI) is to be standard 4 - 20 ma transmitter, 0 – 5 VDC, 2-10 VDC or 0-10 VDC.
  - .3 Binary Output (BO) also known as Digital Output contacts rated at 24 V.D.C., 20 mA.
  - .4 Analogue Output (AO) to be standard 4 to 20 mA or 0-10 V.D.C. @ 20 mA maximum.
- .10 Each output on major controllers shall have an ON, OFF, AUTO select with status indication lamp and internal voltage source.
- .11 Controls shall be D.D.C. solid state type as noted elsewhere, and with exception of actuators, contain no moving parts.
- .12 Building level controllers must have real time clocks. Time keeping methods that depend on the clock speed of the processor chip are not accurate enough and are not acceptable. One designated controller shall keep the time for the entire system.
- .13 Control algorithms shall be available and resident in digital system controller to permit proportional, integral derivative, incremental, floating and two position control modes in any combination to meet requirements of application.
- .14 Canned packages shall not be permitted in controllers. Controllers must be flexible enough to accommodate custom programs and additional points.
- .15 Digital system controller shall be expandable by adding additional field interface units that operate through processor of digital controller to expand its control loop and energy management point capacity, without making any of the original equipment redundant.
- .16 To maintain long term analog accuracy in controller sensing circuits, digital controller shall sense voltage being supplied to resistance sensing element and through firmware compensate for power supply.
- .17 The non-volatile EPROM memory shall, as a minimum, support the operating system. Tape or disk media is not acceptable. All control languages, application functions and operating data or software shall reside in SuperCap or battery backed RAM. Data or control software (such as I/O point characteristics, schedules, set points and alarm limits) must remain in RAM and, hence, modifiable on-line through an operators terminal connected to any panel on the system or from a remote location via modem without the use of specialized software not provided in this contract. Controllers using batteries that require periodic replacement shall not be used. Standard off the shelf communications software packages are acceptable but in no case shall a hardware key or any other protection method be permitted that restricts the Board from connection to the system from multiple remote locations to display system command language and graphics displays.

- .18 All BMS components must be internally protected from loss of memory or operation due to power surges and brown outs. Controllers must be capable of operating without overheating or other damage at as little as 75% of nominal voltage, and as much as 125% of nominal voltage on the secondary side of the control transformers.

## **2.3 BUILDING CONTROLLERS**

- .1 The Building Controller shall be able to operate as a standalone panel and shall not be dependent upon any higher level computer or another controller for operation.
- .2 Provide all processors, power supplies, and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
- .3 DDC controllers shall use the same programming language and tools. DDC controllers, which require different programming language or tools on a network, are not acceptable.
- .4 Modular Controller
  - .1 This controller shall have the BTL listing and meet the BACnet device profile of a Building Controller (B-BC) and shall the BACNet BIBBs required to provide a complete and operable system:
  - .2 The Building Level Controller shall support the following Data Link Layers:
    - .1 BACnet IP Annex J.
    - .2 BACnet IP Annex J Foreign Device.
    - .3 MS/TP Master (Claus 9).
  - .3 The Building Level Controller shall be able to interact with all of the BACnet objects in the controllers. In addition, the software shall be able to support the following objects as they relate to features in the workstation software:
    - .1 Calendar – Creatable, Deletable.
    - .2 Command – Creatable, Deletable.
    - .3 Event Enrollment – Creatable, Deletable.
    - .4 Notification Class – Creatable, Deletable.
    - .5 Schedule - Creatable, Deletable.
  - .4 The Building Level Controller shall support transmitting and receiving segmented messages.
  - .5 The Building Level Controller shall have the capability to be the BACnet/IP Broadcast Management Device (BBMD) and support foreign devices.
  - .6 The Building Level Controller shall have the capability to act as a BACnet router between MS/TP subnetworks and BACnet/IP.
  - .7 Computing power and memory minimum
    - .1 A 32 bit, stand alone, multi tasking, multi user, real-time 100MHz digital control microprocessor module.
    - .2 Inputs shall be 16-bit minimum analog-to-digital resolution.
    - .3 Outputs shall be 10-bit minimum digital-to-analog resolution.

- .4 Memory module (24 Megabyte, minimum) to accommodate all Primary Control Panel software requirements, including but not limited to, its own operating system and databases (see Controllers Software section), including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, password protected operator I/O, dial up communications.
- .5 Real time clock and battery.
- .6 Data collection/ Data Trend module sized for 10,000 data samples.
- .7 Flash Memory Firmware: Each Building Level Control Panel shall support firmware upgrades without the need to replace hardware.
- .8 Onboard or Modular hardware and connections:
  - .1 Primary Network communication module, if needed for primary network communications.
  - .2 Secondary Network communication module, if needed for secondary network communications.
  - .3 RJ45 port 10/100Mbaud.
  - .4 RS485 ports for subnetworks and point expansion.
  - .5 Man to Machine Interface port (MMI).
  - .6 USB Port.
- .9 Input and Output Points Hardware
  - .1 Input/output point modules as required including spare capacity.
  - .2 Input/output point modules shall have removable terminal blocks.
  - .3 Monitoring of the status of all hand off auto switches.
  - .4 Monitoring of all industry standard types of analog and digital inputs and outputs, without the addition of equipment to the primary control panel.
  - .5 Local status indication for each digital input and output for constant, up to date verification of all point conditions without the need for an operator I/O device. Each primary control panel shall perform diagnostics on all inputs and outputs and a failure of any input or output shall be indicated both locally and at the operator workstation.
  - .6 Graduated intensity LEDs or analog indication of value for each analog output.
- .10 Accessories:
  - .1 Appropriate NEMA rated metal enclosure.
  - .2 Power supplies as required for all associated modules, sensors, actuators, etc.
- .5 Compact Controllers
  - .1 Compact Controllers shall be a 16-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors.

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- .2 Each Compact Controller shall have sufficient memory to support its own operating system and databases, including:
    - .1 Control processes.
    - .2 Energy management applications.
    - .3 Alarm management applications including custom alarm messages for each level alarm for each point in the system.
    - .4 Historical/trend data for points specified.
    - .5 Maintenance support applications.
    - .6 Custom processes.
    - .7 Operator I/O.
    - .8 Network communications.
  - .3 Compact Controllers shall provide a data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals.
  - .4 Compact Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.
  - .5 Accessories:
    - .1 Appropriate NEMA rated metal enclosure.
    - .2 Power supplies as required for all associated modules, sensors, actuators, etc.
  - .6 The operator shall have the ability to manually override automatic or centrally executed commands at the primary control panels via local, point discrete, on board hand/off/auto operator override switches. If on board switches are not available, provide separate control panels with HOA switches. Mount panel adjacent to primary control panel. Provide hand/off/auto switch for each digital output, including spares.
  - .7 Each Building Level Control Panel shall continuously perform self diagnostics on all hardware modules and network communications. The System Level Control Panel shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication with any system.
  - .8 Panel setup, point definitions and sequencing diagrams shall be backed up on EEPROM memory.
  - .9 Building Level control panels shall provide at least two data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. Primary control panels shall allow temporary use of portable devices without interrupting the normal communications, operation of permanently connected modems, printers or terminals.
  - .10 Building Level Controllers shall have the capability to serve as a gateway between Modbus subnetworks and BACnet objects. Provide software, drives and programming.

- .11 Immunity to power and noise:
  - .1 Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
  - .2 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).
- .12 In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days.
  - .1 Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
  - .2 Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local connection port, via telephone line dial-in or from a network workstation PC.

## 2.4 BUILDING LEVEL CONTROLLER LEVEL SOFTWARE

- .1 General
  - .1 **Provide a full capability user license to the owner for the operator to be able to see, modify, create, upload, download and save control programs to the DDC controllers.**
  - .2 The software programs specified in this section shall be provided as an integral part of DDC Controllers and shall not be dependent upon any higher level computer for execution.
  - .3 The software application shall be accessible from a PC using the Windows environment but shall use all of its own services and data files so as to not be susceptible to Microsoft Windows operating system's based viruses.
  - .4 The Building Controller Software shall be capable of BACnet communications. The BACnet Building Controller (B-BC) shall have demonstrated interoperability during at least one BTL Interoperability Workshop and have demonstrated compliance to BTL through BTL listing.
- .2 System Security
  - .1 User access shall be secured using individual security passwords and user names.
  - .2 Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.
  - .3 Building Controllers shall be able to assign a minimum of 50 passwords access and control priorities to each point individually. The logon password (at any Operator Interface or portable operator terminal) shall enable the operator to monitor, adjust and control only the points that the operator is authorized for. All other points shall not be displayed at the Operator Interface or portable terminal. Passwords and priorities for every point shall be fully programmable and adjustable.

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- .4 User Log On/Log Off attempts shall be recorded.
  - .5 The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.
  - .6 Use of workstation resident security as the only means of access control is not an acceptable alternative to resident system security in the DDC controller software.
  - .7 Passwords shall have the option to be configured to expire within a selected timeframe (1-365 days).
  - .8 Configuring the password expiration shall also enable the functionality to lock out a user account after three failed log-on attempts.
- .3 User Defined Control Applications: The application software shall program DDC routines to meet the sequences of operations.
- .1 The Building Controllers shall have the ability to perform the following pre tested control algorithms:
    - .1 Two position with differential control and time delays
    - .2 Floating control
    - .3 Proportional control
    - .4 Proportional plus integral control
    - .5 Proportional, integral, plus derivative control
    - .6 Automatic tuning of control loops
    - .7 Model-free adaptive control
    - .8 Start Stop Time Optimization
  - .2 Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
  - .3 Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.

- .4 DDC Controllers shall have the ability to perform energy management routines for the purposes of optimizing energy consumption while maintaining occupant comfort. Routines shall include but are not limited to time of day scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides, start stop time optimization, automatic daylight savings time switch over, night setback control, enthalpy switch over, peak demand limiting, temperature-compensated duty cycling, heating/cooling interlock, supply temperature reset, priority load shedding, and power failure restart.
  - .1 Start-Stop Time Optimization (SSTO) shall automatically be coordinated with event scheduling. The SSTO program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by time of occupancy. The SSTO program shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period and still maintain desired comfort conditions.
    - .1 The SSTO program shall operate in both the heating and cooling seasons.
      - .1 It shall be possible to apply the SSTO program to individual fan systems.
      - .2 The SSTO program shall operate on both outside weather conditions as well as inside zone conditions and empirical factors.
    - .2 The SSTO program shall meet the local code requirements for minimum outside air while the building is occupied.
  - .2 Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or groups of points according to a stored time.
    - .1 It shall be possible to individually command a point or group of points.
    - .2 For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start and stop within that group.
    - .3 The operator shall be able to define the following information:
      - .1 Time, day
      - .2 Commands such as on, off, auto, occupied, unoccupied and so forth.
      - .3 Time delays between successive commands.
      - .4 There shall be provisions for manual overriding of each schedule by an appropriate operator.

- .4 It shall be possible to schedule events up to one year in advance.
  - .1 Scheduling shall be calendar based.
  - .2 Holidays and exceptions shall allow for different schedules.
- .3 Enthalpy switchover (economizer). The Energy Management Control Software (EMCS) will control the position of the air handler relief, return, and outside air dampers and/or the position of the E/HRV bypass damper. If the outside air dry-bulb temperature falls below changeover set point the EMCS will modulate the dampers to provide 100 percent outside air. The user will be able to quickly changeover to an economizer system based on dry bulb temperature and will be able to override the economizer cycle and return to minimum outside air operation at any time.
- .4 Temperature-compensated duty cycling.
  - .1 The DCCP (Duty Cycle Control Program) shall periodically stop and start loads according to various patterns.
  - .2 The loads shall be cycled such that there is a net reduction in both the electrical demands and the energy consumed.
- .5 Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.
- .6 Night setback control: The system shall provide the ability to automatically adjust set points for night control.
- .7 The Peak Demand Limiting (PDL) program shall limit the consumption of electricity to prevent electrical peak demand charges.
  - .1 PDL shall continuously track the amount of electricity being consumed, by monitoring one or more electrical kilowatt-hour/demand meters. These meters may measure the electrical consumption (kWh), electrical demand (kW), or both.
  - .2 PDL shall sample the meter data to continuously forecast the demand likely to be used during successive time intervals.
  - .3 If the PDL forecasted demand indicates that electricity usage is likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads.
  - .4 Once the demand peak has passed, loads that have been shed shall be restored and returned to normal control.
- .5 A single process shall be able to incorporate measured or calculated data from any and all other DDC and HVAC Mechanical Equipment Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC and HVAC Mechanical Equipment Controllers on the network. Database shall support 30-character, English language point names, structured for searching and logs.
- .6 DDC Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task-orientated information from the user manual.



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- .4 Peer-to-peer access to other DDC controllers
    - .1 It shall be possible to use any actual or virtual point data or status, any system calculated data, a result from any process, or any user-defined constant in any controller in the system without dependence upon a central or intermediate processing device.
    - .2 Any process shall be able to issue commands to points in any and all other controllers in the system.
    - .3 Processes shall be able to generate operator messages and advisories to other operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of an advanced annunciation feature, such as:
      - .1 Generate a report
      - .2 Annunciate an alarm
      - .3 Issue a text message or email
    - .4 DDC and HVAC mechanical equipment controllers shall send alarm reports to multiple workstations without dependence upon a central or intermediate processing device.
    - .5 The peer-to-peer network shall also allow any DDC and HVAC mechanical equipment controller to access, edit, modify, add, delete, back up, and restore all system point database and all programs.
  - .5 Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC and HVAC mechanical equipment controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC controllers ability to report alarms be affected by either operator or activity at a pc workstation, local i/o device, or communications with other panels on the network.
    - .1 All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
    - .2 Conditional alarming shall allow generation of alarms based upon user defined multiple criteria.
    - .3 An alarm "shelving" feature shall be provided to disable alarms during testing of systems.
    - .4 Binary Alarms shall be set to alarm based on the operator specified state. Provide the capability to automatically and manually disable alarming.
    - .5 Analog alarms shall have both high and low alarm limits. Provide the capability to automatically and manually disable alarming.
    - .6 The user shall be able to define the specific system reaction for each point. Each DDC Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
    - .7 Alarm reports and messages will be directed to a user-defined list of operator devices or PCs based on time (after hour's destinations) or based on priority.

- .8 In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
  - .9 Operator selected alarms shall be capable of initiating a trigger to an advanced annunciation, such as text, email, etc.
  - .10 An alarm history log shall report the start of the alarm condition, acknowledgement by a user and return of the alarm to normal condition.
  - .11 Remote Communication. The system shall have the ability to remotely communicate to the remote monitoring station.
- .6 Provide a PID (proportional-integral-derivative) closed-loop control algorithm with direct or reverse action and anti-windup. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, setpoint, and weighting parameters shall be accessible from the operator workstation.
- .7 Adaptive Loop Tuning
- .1 Building Controllers shall also provide high resolution sampling capability for verification of DDC control loop performance. Documented evidence of tuned control loop performance shall be provided on a monthly, seasonal, quarterly, annual period.
  - .2 For Model-Free Adaptive Control loops, evidence of tuned control loop performance shall be provided via graphical plots or trended data logs. Graphical plots shall minimally include depictions of setpoint, process variable (output), and control variable (e.g., temperature). Other parameters that may influence loop control shall also be included in the plot (e.g., fan on/off, mixed-air temp).
  - .3 For PID control loops, operator-initiated automatic and manual loop tuning algorithms shall be provided for all operator-selected PID control loops. Evidence of tuned control loop performance shall be provided via graphical plots or trended data logs for all loops.
    - .1 In automatic mode, the controller shall perform a step response test with a minimum one-second resolution, evaluate the trend data, calculate the new PID gains and input these values into the selected LOOP statement.
    - .2 Loop tuning shall be capable of being initiated either locally at the Building Controller, from a network workstation or remotely using dial-in modems. For all loop tuning functions, access shall be limited to authorized personnel through password protection.
- .8 Logic programming: Provide a software routine that can build ladder logic to control using many conditional statements.
- .1 The logic programming syntax shall be able to combine ladder logic with other software features, such as combining status, scheduling, PDL and alarm conditions into one conditional decision.
  - .2 Logic programming shall be able to reference conditions in any other controller in the system.

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- .9 Staggered Start:
- .1 This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts, shall be user definable in an application and shall not require written scripts or ladder logic.
  - .2 Upon the resumption of power, each Building Controller shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.
- .10 Totalization Features:
- .1 Run-Time Totalization. Building Controllers shall automatically accumulate and store run-time hours for all digital input and output points. A high runtime alarm shall be assigned, if required, by the operator.
  - .2 Consumption totalization. Building Controllers shall automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for all analog and digital pulse input type points.
  - .3 Event totalization. Building Controllers shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly or monthly basis for all points. The event totalization feature shall be able to store the records associated with events before reset.
- .11 A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the i/o summary. The entire collection process shall be automated so that the data collection definition, amount of data to be collected, collection report and scheduling take the form a wizard, or online assist utility, in order to complete this process within a short amount of time for a large group of points. Ability to produce a summary of changes in a log file.
- .12 Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of 1 minute to 7 days shall be provided. Each DDC shall have a dedicated RAM-based buffer for trend data and shall be capable of storing data samples. All trend data shall be available for transfer to a Workstation without manual intervention.
- .1 Time-interval based trending shall have the capability of synchronizing the trend sampling of discrete points. This allows for the comparison of values of several different points at the same moment in time.
  - .2 Trended points shall have the option of sampling data values based on the condition of a “trigger” point (i.e., conditional trending). Options for sampling shall include always sampling as defined, only sampling when the trended point is in the alarm condition, or not sampling.

- .13 System Coordination. Provide a standard application for the proper coordination of equipment. This application shall provide the operator with a method of grouping together equipment based on function and location. This group may then be used for scheduling and other applications.

## **2.5 ADVANCED APPLICATION CONTROLLERS**

- .1 The Advanced Application level control panel shall be able to operate as a standalone panel and shall not be dependent upon any higher level computer or another controller for operation.
- .2 The Advanced Application Controller Software shall be capable of BACnet communications. The BACnet Advanced Application Controller (B-AAC) shall have demonstrated compliance to BTL through BTL listing and shall substantially conform to BACnet Advanced Application Controller (B-AAC) device profile. Support all required BACnet BIBBS that are required to provide a complete and operable system.
- .3 The Advanced Application Controller shall be able to interact with all of the BACnet objects in the controllers. In addition, the software shall be able to support the following objects as they relate to features in the workstation software:
  - .1 Calendar – Creatable, Deletable.
  - .2 Command – Creatable, Deletable.
  - .3 Event Enrollment – Creatable, Deletable.
  - .4 Notification Class – Creatable, Deletable.
  - .5 Schedule - Creatable, Deletable.
- .4 The Advanced Application Controller shall support transmitting and receiving segmented messages.
- .5 Communication: The Advanced Application Controller shall support the communications protocols and methodologies indicated in Specification Section 25 05 02 – Network Architecture and Wiring.
- .6 Serial Communication: Temporary use of portable devices shall not interrupt the BAS communication, nor the normal operation of permanently connected printers or terminals.
  - .1 Provide at least one EIA-232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, and portable laptop operator's terminals.
  - .2 A USB port shall alternatively be available to support local HMI tools connection.
- .7 Input/Outputs
  - .1 Inputs shall be 16-bit minimum digital resolution.
  - .2 Outputs shall be 10-bit minimum digital resolution.
- .8 The following I/O port types shall be available on the controller
  - .1 Universal Input (software configurable):
  - .2 Digital Input choices:
    - .1 Pulse Accumulator.

- .2 Contact Closure Sensing.
  - .3 Dry Contact/Potential Free inputs only.
  - .4 Digital Input (10 ms settling time).
  - .5 Counter inputs up to 20 Hz, minimum pulse duration 20 ms (open or closed).
- .3 Analog Input Choices:
  - .1 0-10 Vdc.
  - .2 4-20 Ma.
  - .3 1K Ni RTD @ 32°F (Siemens, JCI, DIN Ni 1K).
  - .4 1K Pt RTD (375 or 385 alpha) @ 32°F.
  - .5 10K NTC Type 2 or Type 3 Thermistor.
  - .6 100K NTC Type 2 Thermistor.
- .4 Universal Input or Output (software configurable):
  - .1 All of the above input types.
  - .2 Analog Output Types:
    - .1 0 to 10 Vdc @ 1 mA max
- .5 Super Universal Input or Output (software configurable):
  - .1 All of the above input types.
  - .2 All of the above output types.
  - .3 Super digital output type:
    - .1 0 to 24 Vdc, 22 mA max. (for controlling pilot relay)
  - .4 Super Analog Output Choices:
    - .1 0 to 20 mA @ 650  $\Omega$  max.
- .6 Provide software configurable I/O ports such that a programmer make a port either an input or an output.
- .9 Each System Level Control Panel shall, at a minimum, be provided with:
  - .1 A 32 bit, multi tasking, real-time 100 MHz digital control microprocessor with plug-in, enclosed processors.
  - .2 Each Advanced Application Controller shall have sufficient memory, a minimum of 24 megabyte, to support its own operating system and databases, including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, and operator I/O.
  - .3 Real time clock and battery.
  - .4 Data collection/ Data Trend module sized for 10,000 data samples.
  - .5 Power supplies as required for all associated modules, sensors, actuators, etc.
  - .6 Monitoring of all industry standard types of analog and digital inputs and outputs, without the addition of equipment to the primary control panel.
  - .7 Local status indication for each digital input and output for constant, up to date verification of all point conditions without the need for an operator I/O device.

- .8 Each control panel shall perform diagnostics on all inputs and outputs and a failure of any input or output shall be indicated both locally and at the operator workstation.
- .9 Graduated intensity LEDs or analog indication of value for each analog output.
- .10 Power loss. In the event of the loss of 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 the operating system software and firmware.
  - .1 Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
  - .2 Brownout protection and power recovery circuitry protect the controller board from power fluctuations.
  - .3 Battery backup shall be provided to support the real-time clock for 10 years
  - .4 The program and database information stored SDRAM memory shall be battery backed for a minimum of 30 days and up to 60 days. This eliminates the need for time consuming program and database re-entry in the event of an extended power failure.
- .11 Database Restore: Each AAC controller shall automatically save the latest programmed database. The controller shall be able to automatically restore a lost or corrupt database without involvement from the operator.
- .12 Each System Level Control Panel shall continuously perform self diagnostics on all hardware modules and network communications. The System Level Control Panel shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication with any system.
- .13 Each Control Panel shall support firmware upgrades without the need to replace hardware.
- .14 System Level control panels shall provide at least two data communication ports for operation of operator I/O devices such as operator terminals, and additional memory. Control panels shall allow temporary use of portable operator interface devices without interrupting the normal communications.
- .15 Immunity to noise: 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).

## **2.6 ADVANCED APPLICATION CONTROLLER SOFTWARE**

- .1 General
  - .1 Provide a full capability user license to the owner for the operator to be able to see, modify, create, upload, download and save control programs to the DDC controllers.
  - .2 The software programs specified in this section shall be provided as an integral part of DDC Controllers and shall not be dependent upon any higher level computer for execution.
  - .3 The software application shall be accessible from a PC using the Windows environment but shall use all of its own services and data files so as to not be susceptible to Microsoft Windows operating systems based viruses.

- .2 Advanced Application Controllers shall have the ability to perform energy management routines including but not limited to
  - .1 scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides
  - .2 automatic daylight savings time switch over
  - .3 night setback control
  - .4 economizer switch over using enthalpy, dry bulb or a combination
  - .5 peak demand limiting,
  - .6 temperature-compensated duty cycling
  - .7 heating/cooling interlock
  - .8 supply temperature reset
  - .9 priority load shedding
  - .10 power failure restart
- .3 The software shall have a routine for automatic tuning of control loops
- .4 System Security in the Field Panel
  - .1 User access shall be secured using individual security passwords and user names.
  - .2 Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.
  - .3 The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.
  - .4 Use of workstation resident security as the only means of access control is not an acceptable alternative to resident system security in the field panel.
- .5 User Defined Control Applications:
  - .1 Controllers shall be fully-programmable. Controllers shall execute custom, job-specific sequences to automatically perform calculations and special control routines. Factory installed or pre-configured sequences shall only be allowed if they exactly match the sequence specified herein.
  - .2 Programs shall combine control logic, control loop algorithms, and energy management routines
  - .3 Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.
  - .4 Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task oriented information from the user manual
- .2 Adaptive Loop Control:
  - .1 Each AAC controller shall come standard with an Adaptive Control Loop Algorithm
    - .1 Tuning parameter shall automatically adjust for non-linear applications

- .2 Model-Free Adaptive (MFA) algorithm
  - .1 The algorithm shall not require modeling of the non-linear system in order to maintain control at all points of the non-linear load.
  - .2 The controlled variable, setpoint, and weighting parameters shall be user-selectable.
- .3 Output shall be analog or shall stage a series of outputs.
- .4 Adaptive Control shall take the place of Proportional, Proportional + Integral, and PID type algorithms for non-linear applications. Adaptive Control routines shall:
  - .1 Improve response time.
  - .2 Improve System efficiency.
  - .3 Improve Stability.
  - .4 Result in Consistent outputs.
  - .5 Reduce cycling and repositioning.
  - .6 Reduce wear and tear on actuators.
- .5 Adaptive control shall auto-adjust to compensate for
  - .1 Mode changes.
  - .2 Load changes.
  - .3 Seasonal changes.
  - .4 Heating and cooling changeover.
  - .5 Heating or cooling capacity changes on the primary side.
  - .6 Flow changes on the primary or secondary side.
  - .7 Airflow changes across coil.
  - .8 Flow across a heat exchanger.
- .6 Adaptive control shall auto-adjust to compensate for
  - .1 Non-linear coils and heat exchangers.
  - .2 Hot water and chilled water reset routines.
  - .3 Water flow reset routines.
  - .4 Duct Static reset routines.
- .7 Auto-Tune PID loops are not acceptable substitutions.
- .8 If Adaptive Loop Control is not available, then the BAS contractor shall provide re-tuning of the control loops for coils and heat exchangers for each of the following conditions:
  - .1 Low heating supply water, high heating supply water.
  - .2 Low load on steam coil, high load on steam coil.
  - .3 Chilled water coil, non dehumidification and condensing.
  - .4 Chilled water coil, low airflow, high airflow, economizer.
  - .5 Dual temperature systems tune for heating and cooling modes.
  - .6 Each of 4 seasons.



## **2.7 APPLICATION SPECIFIC CONTROLLERS (ASC)**

- .1 Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.
- .2 All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the floor, building or management level networks is not acceptable.
- .3 Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.
  - .1 Provide for control of each piece of terminal equipment where indicated.
  - .2 Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24V floating control, allowing for interface to a variety of modulating actuators. Terminal controllers utilizing proprietary control signals and actuators shall not be acceptable.
  - .3 Each controller performing space temperature control shall be provided with a matching room temperature sensor. The sensor may be either RTD or thermistor type providing the minimum performance requirements of +/- .6 deg. C accuracy, operating in the range of +/- .6 C° ( $\pm 1F^{\circ}$ ) accuracy, operating in the range of 2 to 46°C (36°F to 115°F), adjustable between 2°C to 30°C (36°F to 86°F).
  - .4 Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. The temperature indicator shall be digital readout visible without removing the sensor cover.
  - .5 Each controller shall perform its primary control function independent of other DDC Controller LAN communication, or if LAN communication is interrupted. Reversion to a fail-safe mode of operation during interruption is not acceptable. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) gains for all applications.
  - .6 Provide each terminal equipment controller with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or 72-hour battery backup shall be provided. Controllers that require factory changes of all applications are not acceptable.

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**Part 3                      Execution**

**3.1                      CONTROLLER APPLICATIONS**

- .1 Building Level Controllers shall be used for the following types of systems. It is intended that each unique system be provided with its own point resident DDC Controller.
  - .1 Heating plant systems.
  - .2 Pumping systems.
  - .3 VAV air handlers.
  - .4 Air handlers over 15,000 cfm.
  - .5 Systems with over 24 input/output points.
- .2 Advanced Application Controllers shall be used for systems with custom sequences that meet all of the criteria below:
  - .1 No primary pumping systems.
  - .2 Secondary Pumping systems that are remote from Central Plants.
  - .3 Air handlers up to 15,000 cfm.
  - .4 Systems up to 20 input/output points.
  - .5 BAS Network or Architecture or Sequences do not require the system to be on an IP network.
  - .6 No systems that require integration to meters, VFDs or other smart equipment.
  - .7 Integration to smart thermostats is allowed.
  - .8 When application specific controllers are not allowed.
  - .9 Rooftop systems.
- .3 Application Specific Controllers are intended to be used for only the following systems:
  - .1 Variable Air Volume (VAV) boxes
  - .2 Constant Air Volume (CAV) boxes
  - .3 Unit Conditioners

**3.2                      CONTROLLER INSTALLATION**

- .1 Install all DDC controllers in heated space. Keep all electronic equipment away from temperature extremes and wild fluctuations and shielded from electromagnetic interference.
- .2 Proposed panel locations shall be approved by Engineer/Board. Panels containing controllers shall be installed only in heated areas not subject to extremes of temperature or rapid temperature variations.
- .3 Label all wiring at termination point, reflect labelling in as-built shop drawings.
- .4 Isolation shall be provided at all primary control panel terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standards 587 1980.

- .5 Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
  - .1 RF-Conducted Immunity (RFI) per ENV 50141 (IEC 1000-4-6) at 3 V.
  - .2 Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact.
  - .3 Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power.
  - .4 Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max).
- .6 Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:
  - .1 IEEE Standard 587-1980.
  - .2 UL 864 Supply Line Transients.
  - .3 Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11).
- .7 Install all panels in a metal enclosure. Use of controller plastic enclosures is not acceptable.

### **3.3 FUTURE EXPANSION**

- .1 Controllers shall perform all of the functions described in these specifications, including all of the options described even if the options are not required in the initial work.
- .2 Controllers shall have an allowance of a minimum of 10% in spare points for each type of point.
- .3 If a certain type of point is not associated with a specific panel, the required minimum spare points shall be two (2).

### **3.4 PANELS**

- .1 Local equipment cabinets shall be provided for each controller or group of controllers, of free standing or wall mounted type. Respective controllers, transducers, shall be mounted within cabinet. Relays, transformers and any other devices using a voltage above 24 VAC must be housed in a separate enclosure from the controllers. Transformers may be enclosed type, mounted outside of the enclosures. Panel instruments shall be designated as to type and function of black Lamicoid tags 6.4 mm white engraved, secured with drive screws. Cabinets shall be located where shown or as later directed and may be grouped per Mechanical Room.
- .2 Control panels shall be fully enclosed cabinets with all steel constructions. Cabinets shall have hinged door with locking latch or bolt on cover plate. All cabinet locks shall be common keyed.
- .3 Controller Panels
  - .1 Controllers in mechanical rooms shall be mounted in NEMA 1 enclosures.
  - .2 Controllers in areas where moisture is a concern shall be mounted in NEMA 12 enclosures.
  - .3 Controllers installed outdoors shall be mounted in NEMA 4X enclosures. Provide heaters where freezing temperatures are normally experienced.

- .4 Provide power supplies for control voltage power.
- .5 Dedicate 1 power supply to the DDC controller. Other devices shall be on a separate power supply, unless the power for the control device is derived from the controller terminations.
- .6 Power supplies for controllers shall be a transformer with a fuse or circuit breaker. Power supplies for other devices can be plain transformers.
- .7 All power supplies for 24V low voltage wiring shall be class 2 rated and less than 100VA. If low voltage devices require more amps, then provide multiple power supplies. If a single device requires more amps, then provide a dedicated power supply in a separate enclosure and run a separate, non-class 2 conduit to the device.
- .8 Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC Controllers and operator's workstations.
- .9 All devices in a panel shall be permanently mounted, including network switches, modems, media converters, etc.
- .10 Provide a pocket to hold documentation.
- .11 Panels shall be wall mounted or free standing and shall be as located on the mechanical drawings.
- .12 All relays, transducers etc., shall be located within the control panels.
- .13 Each DDC Controller enclosure shall have a standard duplex AC power receptacle located within the enclosure to provide power for test equipment, operation communication devices.
- .14 Enclosures shall be large enough to accommodate the components without crowding, after allowing sufficient space for good wiring management. In all cases, the local field panel must have a minimum of 25% free mounting area within the enclosure
- .15 If the DDC controllers come with plastic enclosures, the plastic enclosures must be themselves enclosed in a metal enclosure.

### **3.5 WARRANTY**

- .1 Refer to Division 1.
- .2 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .3 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .4 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

**Part 1**            **General**  
**Not Used**

**Part 2**            **Products**

**2.1**                **ACCEPTABLE MANUFACTURERS**

- .1 Any devices listed in this specification shall be branded by the BAS supplier or one of the following manufacturers:
  - .1 Sensors, Relays Etc.
    - .1 Greystones
    - .2 Enercorp
    - .3 Johnson
    - .4 Siemens
    - .5 ACI
    - .6 Honeywell
    - .7 Setra
  - .2 Thermostats
    - .1 Match BAS provider
    - .2 Match Split Heat Pump Provider where applicable
  - .3 Control Valves
    - .1 Siemens
    - .2 Belimo
    - .3 Johnson Controls
  - .4 Actuators
    - .1 Siemens
    - .2 Belimo
    - .3 Johnson Controls
    - .4 Honeywell
    - .5 Schneider Electric

**2.2**                **GENERAL REQUIREMENTS**

- .1 Actuation of control devices shall be electronic. Spring return fail-safe actuation shall be provided when loss of property and/or property damage is possible and where specified.
- .2 All equipment, unless specified to contrary, shall be fully proportioning, modulating in operation.

- .3 Space and duct sensors shall be electronic suitably located for specific application. Space sensing units shall be mounted 1500 mm from floor to centre for non-adjustable and 1200 mm from floor for adjustable unless otherwise noted or agreed to by the consultant.
- .4 Sensors shall meet or exceed the specified standards.
- .5 All sensors shall be capable of operating over the expected operating range and humidity.

### **2.3 MOTORIZED CONTROL DAMPERS**

- .1 Control dampers shall be the parallel or opposed blade type as below or as scheduled on drawings.
  - .1 Outdoor and/or return air mixing dampers and face and bypass (F & BP) dampers shall be parallel blade, arranged to direct air-streams toward each other.
  - .2 Other modulating dampers shall be the opposed blade type.
  - .3 Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.
- .2 Damper frames shall be 13 gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.
- .3 Damper blades shall not exceed 20 cm (8") in width or 125 cm (48") in length. Blades are to be suitable for medium velocity performance (10 m/s [2000 fpm]). Blades shall be not less than 16 gauge.
- .4 Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze or better.
- .5 All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 1% of total flow based on a approach velocity of 7.62 m/s (1500 ft/min) at 1000 Pa (4 in. w.g.) differential pressure. Provide air foil blades suitable for a wide-open face velocity of 7.5 m/s (1500 fpm).
- .6 Individual damper sections shall not be larger than 125 cm x 150 cm (48" x 60"). Provide a minimum of one damper actuator per section.
- .7 Modulating dampers shall provide a linear flow characteristic where possible.
- .8 Dampers shall have exposed linkages.
- .9 Aluminum Airfoil Dampers
  - .1 Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades to be 6" wide single air foil design.
  - .2 Frames shall be extruded aluminum channel and grooved inserts for vinyl seals. Standard frames 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other sides.

- .3 Pivot rods shall be 7/8" hexagon extruded aluminum interlocking into 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.
- .4 Bearing shall be designed so that there is no metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.
- .5 Blade linkage hardware is to be installed in frame out of airstream. All hardware to be on non-corrosive reinforced material or cadmium plated steel.
- .6 Damper seals shall be designed for minimum air leakage by means of overlapping seals.
- .7 Damper blades shall be maximum 48" long per section
- .8 Dampers greater than 1 section wide shall be arranged so they can be operated from either side. Note: this means the maximum damper width is 96". No jackshafts shall be used.
- .9 **Dampers on building exterior to be the insulated type.**

## 2.4 CONTROL VALVES

- .1 General:
  - .1 All automatic control valves shall be fully proportioning, unless specified otherwise. The valves shall be quiet in operation and fail safe in normally open position unless specified otherwise. All valves shall be capable of operating at varying rates of speed to correspond to the exact dictates of the controllers and variable load requirements. The valves shall be capable of operating in sequence with other valves and/or dampers when required by the sequence of operation. All control valves shall be suitable for the pressure conditions and shall close against the differential pressures involved.
  - .2 All control valves shall be sized by the control vendor and be guaranteed to accommodate the flow rates as scheduled.
  - .3 The valve seat differential pressure rating shall exceed the pump dynamic head design pressure.
  - .4 All control valve bodies shall be suitable for the static and dynamic pressures of the system. Control valve operators shall be sized to close against a differential pressure equal to the design pump head plus 10 percent.
    - .1 Design body pressure shall be determined by the adding the static pressure due to the height of the system plus the compression tank charge plus the maximum head of the system pump at cut off. Provide 10% design factor.
  - .5 The valve seat differential pressure rating shall exceed the pump dynamic head design pressure.
  - .6 Cold water, hot water and steam valves, throttling type, and bypass valves shall have equal percentage flow characteristics.

- .7 All automatic control valves installed exposed to the elements shall be provided with electric actuators with operating characteristics and accessories as described in herein. Coordinate with electrical contractor for power availability and point of connection.
- .8 All automatic control valves controlled by the BAS shall be furnished by the controls contractor unless noted otherwise in these documents.
- .2 Controlled Media
  - .1 The control valve shall be suitable for chilled water to a minimum of 35°F (2°C) and hot water to a maximum temperature of 250°F (121°C). 3-way 1-1/2" and 2" valves shall be suitable for chilled water to a minimum of 35°F (2°C) and hot water to a maximum temperature of 230°F (110°C). The control valve shall be suitable for up to 50% ethylene or propylene glycol solutions where applicable.
- .3 Threaded Valves, line size 1/2" to 2":
  - .1 Control valve bodies shall be constructed of forged brass according to ASTM B283 (C37700, CuZn39Pb2 or equivalent), and shall meet requirements of ANSI 250 and 600WOG pressure classes.
  - .2 Inlets and outlets shall be clearly marked on the valve bodies.
  - .3 Valve ball shall consist of nickel-plated brass, chrome-plated brass or stainless steel.
  - .4 End connections shall be NPT internally threaded according to ANSI B1.20.1.
  - .5 The control valve flow rate (Cv) shall meet the requirements of ANSI/ISA S75.02.
  - .6 The control valve shall have an equal percentage flow characteristic, according to ANSI/ISA S75.11. A single glass filled PTFE V port insert shall provide both the ball seal and shall establish the flow coefficient of the valve. The V port insert shall be retained by the valve body itself, not requiring additional retaining components. Flow coefficient adapters requiring a retainer clip or installed after final assembly of the valve or as inserts in the ball shall not be allowed.
  - .7 2-way valves and the A-AB path on 3-way valves shall meet the requirements of ANSI Class IV (0.01% of rated Cv) seat leakage, or better, according to ANSI/FCI 70.2, at the specified close-off pressure. Bypass path (B-AB) on 3-way valves shall meet the requirements of ANSI Class III (0.1% of rated Cv) seat leakage, or better, according to ANSI/FCI 70.2.
  - .8 Chilled and Hot water valve shall have a blow-out proof stem with two EPDM (peroxide cured) O-rings. External stem retainers will not be allowed.
  - .9 Valve stem shall be made of brass or stainless steel.
  - .10 Valve shall have the ability to be manually operated in the event of a power failure.
- .4 Flanged Valves, line size 2 1/2" and greater
  - .1 Valves 2 1/2" and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.



.5 Pressure Control Valves:

- .1 Provide for all water systems where modulating water flow conditions are required to prevent excessive pump pressure build-up. Provide a valve for each closed loop water system. Valve to be globe type. Provide valves 2" and smaller with screwed end bodies and provide valves 2-1/2" and larger with flanged ends.

**2.5 ELECTRONIC DAMPER AND VALVE ACTUATORS**

.1 General

- .1 Electric control shall be direct coupled actuators.
- .2 Damper actuators shall be Brushless DC Motor Technology with stall protection, bi-directional, fail safe spring return, all metal housing, manual override, independently adjustable dual auxiliary switch.
- .3 The actuator assembly shall include the necessary hardware and proper mounting and connection to a standard 1/2" diameter shaft or damper blade.
- .4 Actuators shall be designed for mounting directly to the shaft without the need for connecting linkages.
- .5 All actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.
- .6 All actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator's output coupling with the damper shaft. The self-centering clamp shall have a pair of opposed "v" shaped toothed cradles; each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with the damper shaft.
- .7 All actuators having more than a 100 lb-in torque output shall accept a 1" diameter shaft directly, without the need for auxiliary adapters.
- .8 All actuators shall be designed and manufactured using ISO900 registered procedures and shall be Listed under Standards UL873 and CSA22.2 No. 24-93 I.
- .9 Provide visual scale indicating percent of travel.
- .10 Provide feedback signal on all control valves over 2 inches and all damper actuators where specified.
- .11 Actuators shall be UL and CSA listed.

.2 Electronic Valve Actuators

- .1 The valves shall be provided with an actuator by the same manufacturer, factory installed.
- .2 All actuators shall have visual position indication.
- .3 No external programming device shall be required.
- .4 Actuator shall be electric motor driving, microprocessor signal controlled.
- .5 Electric Control Rangeability: 40:1
- .6 Control Signal 0 to 10 VDC or 0 to 20 mA signal. 2 to 10 VDC or 4 to 20 mA operating range.

- .7 Power 24 VAC, 50-60 Hz
- .8 Fail Safe: Valves actuators shall position the valve in a fail safe position when the power supply is disrupted or the signal goes to 0. Fail-safe according to the following guidelines unless otherwise stated in the sequence of operations
  - .1 Power fail safe shall be via spring loaded mechanical means
  - .2 Any AHU hot water exposed to ventilation air shall fail open
  - .3 AHU Chilled water coils exposed to ventilation air in possible freezing conditions shall be fail open
  - .4 Terminal unit valves shall fail-in-place
- .9 Fail in place valves on primary equipment such as chilled water systems, hot water systems and condenser water systems shall have a means to manually open the valve when power is not available, such as a hand wheel or a geared crank with a clutch.
- .10 The actuator shall be designed with a current limiting motor protection. A release button (clutch) or handle on the actuator shall be provided to allow for manual override (except when actuator is spring return type).
- .11 Actuator shall provide minimum torque required for proper valve close-off. The close-off differential pressure rating of the valve shall exceed the highest possible head pressure available at the pump plus 10% and still be rated for a Class IV leakage.
- .12 The actuator shall have the capability of adding auxiliary switches or feedback potentiometer if specified.
- .13 All automatic control valves installed in locations exposed to the elements shall be provided with weather resistant housings and heaters for climates that reach below freezing.
- .3 Electronic Damper Actuators
  - .1 Actuator shall be direct coupled (over the shaft), enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator-to-shaft clamp shall use a "V" bolt and "V" shaped, toothed cradle to attach to the damper shaft for maximum holding strength. Single bolt or set screw type fasteners are not acceptable.
  - .2 Damper operators shall be of the replaceable diaphragm piston type with external adjustable stops to limit the length of stroke in either direction. Operators shall be mounted on adjustable brackets. Operating arms shall have double yoke linkages and double set screws for fastening to damper shaft.
  - .3 Damper operators shall be selected to operate maximum damper loads of 2.6 m<sup>2</sup> (135 ft<sup>2</sup>). Where damper sizes exceed this area rating, multiple damper operators shall be provided.
  - .4 Actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. End switches to deactivate the actuator at the end of rotation or magnetic clutch are not acceptable.
  - .5 For power-failure/safety applications, a mechanical, spring return mechanism

## **2.6 DAMPER STATUS SWITCHES**

- .1 Damper status switches shall be a lever operated, activated by damper blade movement and mounted securely on damper frame.
- .2 Damper switch shall have contact rating of 5 amperes at 120V AC and be CSA approved.

## **2.7 DIFFERENTIAL PRESSURE SENSORS**

- .1 Differential pressure sensors shall be provided for water differential pressure air and static pressure applications.
  - .1 Monitoring Range To suit application
  - .2 Output Signal 4 to 20 mA
  - .3 Accuracy +/- 1.0% full scale
- .2 Select materials suitable for the measured variable, i.e. water and air, and to withstand a minimum of twice the normal pressure.
- .3 The transmitter output shall be linear proportional signal over the full operating range.

## **2.8 FILTER BANK STATUS DIFFERENTIAL PRESSURE SWITCHES**

- .1 Provide switches with SPDT contacts rated at 9 amperes at 120 VAC and be CSA approved.
- .2 Select the differential pressure range of the switch to suit the application.
- .3 Provide switches with adjustable setpoint.
- .4 Mounted switches with diaphragm in a vertical plane.

## **2.9 TEMPERATURE THERMOSTAT (DDC)**

- .1 Digital room sensors without LCD display, day / night override button, and setpoint slide adjustment to  $\pm 5^{\circ}\text{C}$  adjustment and override options. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment.
  - .1 Temperature monitoring range  $+20/120^{\circ}\text{F}$  -  $13^{\circ}$  to  $49^{\circ}\text{C}$
  - .2 Output signal Changing resistance
  - .3 Accuracy at Calibration point  $\pm 0.5^{\circ}\text{F}$  (+/-  $0.3^{\circ}\text{C}$ )
  - .4 Set Point and Display Range  $55^{\circ}$  to  $95^{\circ}\text{F}$  ( $13^{\circ}$  to  $35^{\circ}\text{C}$ )
- .2 Provide metal guards on thermostat in common areas and gymnasiums. Common area thermostats shall not have temperature adjustment.
- .3 Sensor to be 10k wire, thermistor style
- .4 **Provide LCD display of space temperature in offices and training room only.**
- .5 **Do not provide LCD display of space temperature in apparatus bay or antique truck display.**

**2.10 LINE VOLTAGE ROOM THERMOSTATS**

- .1 Provide electric wall mounted 120 volt thermostats as indicated. Each thermostat shall be equipped with a thermometer and shall be tamperproof with locking covers.
- .2 A metal guard and adapter plate shall be supplied for all thermostats mounted in storage areas.

**2.11 FLUID TEMPERATURE SENSORS**

- .1 Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
- .2 The sensor shall have the following characteristics:
  - .1 Range Appropriate to application
  - .2 Output Signal 4 to 20 mA or resistive
  - .3 Accuracy 0.05% of maximum range, max 0.1 C

**2.12 SEPARABLE BRASS THERMOWELLS**

- .1 These shall be provided with immersion type bulbs for installation by plumbing section. (Stainless steel shall be used for immersion in glycol solutions.) Wells shall be packed with thermal conductive grease to increase speed of response. Thermowells shall have 1/2" IPS threads to receive sensor and be of suitable length for the pipe diameter.

**2.13 AIR TEMPERATURE SENSORS**

- .1 Sensors shall be a minimum of 1.5m (5ft) in length per 1 square meter of duct cross section.
- .2 All supply air sensors and mixed air sensors shall be 100 or 1000 OHM platinum, resistance temperature detector (RTD) type with a 7.5 m (25') averaging element. Each RTD may be provided with an industry standard, 4-20mA, transmitter mounted at the RTD as required.
  - .1 Temperature monitoring range -7°C to 49°C (20°F to 120°F)
  - .2 Output signal Changing resistance
  - .3 Accuracy at calibration point  $\pm 0.3C (\pm 0.5F^{\circ})$
- .3 All return air sensors shall be RTD or thermistor type temperature detectors. The sensor probe shall have a minimum length of 450 mm (18"). Each RTD may be provided with an industry standard, 4-20mA, transmitter mounted at the RTD as required.
  - .1 Temperature and monitoring range 4°C to 66°C (40°F to 150°F).
  - .2 Output Signal Changing Resistance
  - .3 Accuracy ant calibration point 0.3C ( $\pm 0.5F^{\circ}$ )

- .4 Outdoor air sensor shall be the PT-100 platinum 3 wire RTD type with a 4-20mA transmitter mounted at the sensor. The RTD shall be mounted in a weatherproof enclosure, the 4-20mA transmitter shall be mounted inside the building within an electrical box.
  - .1 Temperature and monitoring range -18°C to 49°C (0°F to 120°F).
  - .2 Output Signal Changing Resistance
  - .3 Accuracy at calibration point  $\pm 0.3\text{C}$  ( $\pm 0.5\text{F}^\circ$ ) over a range of
- .5 Sensors shall be provided with vented protective covers, mounted 1500 mm (60") from floor level.

#### **2.14 HIGH LIMIT THERMOSTATS**

- .1 Thermostats shall have liquid filled insertion probe.
- .2 Range shall be -3.9 to 101.7 C
- .3 Switch shall be snap acting and rated for 16 amperes at 120 VAC or 8 amperes at 575 VAC as required.
- .4 Thermostat shall have manual reset feature.
- .5 Provide one thermostat for each 1 sq. m of duct area.
- .6 Thermostats shall be CSA approved and have a dust tight enclosure.
- .7 Thermostats shall be SPDT or DPDT to facilitate monitoring by BMS.

#### **2.15 LOW LIMIT THERMOSTATS**

- .1 Thermostats shall have 6000 mm vapour tension sensing element sensitive to a temperature below its setpoint over 300 mm of its length.
- .2 Range shall be 1.7°C to 7.2°C.
- .3 Switch shall be snap acting and rated for 16 amperes at 120 VAC or 8 amperes at 575 VAC as required.
- .4 **Thermostat shall have manual reset feature.**
- .5 Provide one thermostat for each 1 sq. m of coil face area or part thereof.
- .6 Thermostats shall be DPDT to facilitate monitoring by BMS.
- .7 Mount sensing element rigidly and as close as possible to the downstream face of the coil being protected or where shown on schematic diagrams. Freeze controls shall have 6 m capillary arranged in ducts for best possible protection.
- .8 Provide freeze stat for each 5.5 square meters of duct area where necessary, wired in series. Sensing element shall extend at least to two diagonally opposite corners of the coil.

#### **2.16 FLOW SWITCHES**

- .1 Flow-proving switches shall be either paddle or differential pressure type, as shown.

- .2 Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum) and shall have adjustable sensitivity with NEMA 1 enclosure unless otherwise specified.
- .3 Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as specified.
- .4 Flow switch to be DPDT, if possible to facilitate monitoring by BMS.

## **2.17 HUMIDITY SENSORS**

- .1 The humidity sensor shall meet the following operating characteristics:
  - .1 Range 5-90% RH between 0°C to 60°C (32°F to 140°F).
  - .2 Output Signal 4-20 mA
  - .3 Accuracy  $\pm 2\%$  RH over the humidity range
- .2 Duct mounted sensors shall be mounted half way across the duct. Room mounted sensor shall be provided with vented covers.

## **2.18 CO2 DETECTOR**

- .1 The sensor shall be the non-dispersive infrared style.
- .2 The sensor shall meet the following operating characteristics
  - .1 Range 0 to 5000 ppm
  - .2 Output Signal 0 to 10 vDC or 4-20 mA
  - .3 Accuracy  $\pm 50$  ppm
- .3 Outputs shall be configured using optional software package to provide advanced control strategies using CO<sub>2</sub>.
- .4 Sensor shall be self calibrating.
- .5 Wall mounting or duct mounting, depending on application.

## **2.19 ELECTRICAL DEVICES**

- .1 Relays
  - .1 Control relays shall be UL listed plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
  - .2 Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable  $\pm 200\%$  (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

- .2 Override timers.
  - .1 Override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified. Timer shall be suitable for flush mounting on control panel face and located on local control panels or where shown.
- .3 Current transmitters.
  - .1 AC current transmitters shall be the self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, with internal zero and span adjustment and +1 % full-scale accuracy at 500 ohm maximum burden.
  - .2 Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA Recognized.
  - .3 Unit shall be split-core type for clamp-on installation on existing wiring.
- .4 Current transformers.
  - .1 AC current transformers shall be UL/CSA Recognized and completely encased (except for terminals) in approved plastic material.
  - .2 Transformers shall be available in various current ratios and shall be selected for  $\pm 1$  % accuracy at 5 A full-scale output.
  - .3 Transformers shall be fixed-core or split-core type for installation on new or existing wiring, respectively.
  - .4 Status inputs for motors (pumps and fans) shall use inductive coils to monitor current draw from one phase of power.
  - .5 Current transformers shall be selected and configured for appropriate amperage range, and shall have 0 to 5 Volt output
  - .6 BMS shall use AI points to monitor current transformers.
- .5 Voltage transmitters.
  - .1 AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4 to 20 mA output with zero and span adjustment.
  - .2 Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with  $\pm 1$  % full-scale accuracy with 500 ohm maximum burden.
  - .3 Transmitters shall be UL/CSA Recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.
- .6 Voltage transformers.
  - .1 AC voltage transformers shall be UL/CSA Recognized, 600 VAC rated, complete with built-in fuse protection.
  - .2 Transformers shall be suitable for ambient temperatures of 4°C to 55°C (40°F to 130°F) and shall provide  $\pm 0.5$ % accuracy at 24 VAC and a 5 VA load.
  - .3 Windings (except for terminals) shall be completely enclosed with metal or plastic material.

- .7 Power monitors.
  - .1 Power monitors shall be the three-phase type furnished with three-phase disconnect/shorting switch assembly, UL Listed voltage transformers, and UL Listed split-core current transformers.
  - .2 They shall provide a selectable rate pulse output for kWh reading and a 4 to 20mA output for kW reading. They shall operate with 5 A current inputs with a maximum error of  $\pm 2\%$  at 1.0 power factor or  $\pm 2.5\%$  at 0.5 power factor.
- .8 Current switches.
  - .1 Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system. Switch shall be complete with LED and have four turn adjustment.

## **2.20 PHOTO SENSOR**

- .1 Weathertight.
- .2 Operating Temperature  $-30$  to  $+70$  C.
- .3 Resistance at 0 Lux 15 Kohms minimum.
- .4 Resistance at 10 Lux 3 Kohms typical.

## **Part 3 Execution**

### **3.1 NAMEPLATES**

- .1 Duct and pipe mounted sensors and panels shall be provided with minimum size 75 x 25 x 3.2 mm 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.

### **3.2 ACTUATORS**

- .1 Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum  $5^\circ$  available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
- .2 Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.
- .3 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- .4 Provide all mounting hardware and linkages for actuator installation.



- .5 The controls contractor shall provide wiring as follows:
  - .1 All line voltage power for electric valve actuators shall be wired by the controls contractor from the nearest available power panel. Coordinate with electrical trade.
  - .2 All wiring between the central control system (ATC/BMS) and the valve actuator shall be wired by the controls contractor.
  - .3 All wiring between the valve actuator and their associated thermostats, pressure switches, control devices, etc. shall be wired by the controls' contractor.
  - .4 All wiring shall comply with code requirements. Segregate high and low voltage wiring and circuits and segregate the FAS and controls (BMS) terminals.

### **3.3 CONTROL VALVE INSTALLATION**

- .1 Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- .2 All automatic control valves shall be installed by the mechanical trade.
- .3 BAS contractor shall co-ordinate porting of valves with mechanical contractor.
- .4 Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.
- .5 Valves shall be installed in accordance with the manufacturer's recommendations.
- .6 Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- .7 Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system.
- .8 Unions shall be installed at all connections to screw-type control valves.
- .9 Provide tags for all control valves indicating service and number. Tags shall be brass, 1.5" in diameter, with 1/4" high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

### **3.4 CONTROL DAMPER INSTALLATION**

- .1 Damper style and construction shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
- .2 Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4". larger than damper dimensions and shall be square, straight, and level.
- .3 Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 0.3 cm (1/8") of each other.

- .4 Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
- .5 Install extended shaft or jackshaft according to manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
- .6 Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
- .7 Provide a visible and accessible indication of damper position on the drive shaft end.
- .8 Support ductwork in area of damper when required to prevent sagging due to damper weight.
- .9 After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

### **3.5 INSTALLATION OF THERMOSTATS**

- .1 Install sensors in accordance with the manufacturer's recommendations.
- .2 Mount sensors rigidly and adequately for the environment within which the sensor operates.
- .3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- .4 All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- .5 Install thermostats at handicapped elevations 1200 mm above finish floor (AFF).
- .6 Where not indicated on drawing, place where directed by consultant.
- .7 Co-ordinate location with architectural and electrical items.

### **3.6 INSTALLATION OF SENSORS - GENERAL**

- .1 Install sensors in accordance with the manufacturer's recommendations.
- .2 Mount sensors rigidly and adequately for the environment within which the sensor operates.
- .3 All wires attached to sensors shall be air in EMT raceways.
- .4 All din rail or screw mounted transmitters, shall be mounted in steel box of suitable size with removable cover and secured in place.

### **3.7 AIR TEMPERATURE SENSORS**

- .1 Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

- .2 Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m (10 ft.) of sensing element for each 1m<sup>2</sup> (1 ft of sensing element for each 1 ft<sup>2</sup>) of coil area.

### **3.8 LIQUID TEMPERATURE SENSORS**

- .1 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

### **3.9 OUTDOOR AIR TEMPERATURE SENSORS**

- .1 Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

### **3.10 LOW LIMIT THERMOSTATS**

- .1 Locate detectors after preheat coil or before cooling coil in air systems utilizing outside air.

### **3.11 DIFFERENTIAL PRESSURE SENSORS**

- .1 Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
- .2 Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.
- .3 Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.
- .4 All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
- .5 All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.

### **3.12 FLOW SWITCH INSTALLATION**

- .1 Use correct paddle for pipe diameter.
- .2 Adjust flow switch in accordance with manufacturer's instructions.

**3.13            WARRANTY**

- .1      Warranty Start Date:
  - .1      Warranty period starts as of the date of Ready for Takeover.
  - .2      Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2      Warranty Duration:
  - .1      Two (2) year warranty period applies.
- .3      Warranty Coverage:
  - .1      Applies to parts and labour.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 This section is to be read in conjunction with 25 10 01 Building Automation Systems – General Requirements and the remaining Section 25 specifications.

**1.2 BACNET INTEGRATION AND CONTROL POINTS**

- .1 The BAS contractor is responsible to provide a full and operable system that meets all required specifications and sequences.
- .2 The BAS contractor shall provide hard wired control points, sensors and all other components of the system as required to either supplement available BACNet points, or in the absence of a BACNet card make the system completely operable.
- .3 Sequences of operation may or may not be achievable through BACNet integration, as not all points required may be available from the unit manufacturer.
- .4 Not all equipment in the project has been specified with BACNet cards. The BAS contractor is responsible to review the entirety of the mechanical specification to confirm which equipment is being specified with BACNet integration cards and which equipment will not be provided with BACNet integration.
- .5 Quoting or pricing work as BACNet integration only is not acceptable.

**Part 2 Products**

Not Used.

**Part 3 Execution**

**3.1 SYSTEM CONTROL STABILITY AND ACCURACY**

- 1. Control Stability and Accuracy shall maintain measured variable at set-point within tolerances listed below:

Control Stability and Accuracy		
Controlled Variable	Control Accuracy	Range of Medium Accuracy
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1°C (±2°F)	
Duct Temperature	±1.5°C (±3°F)	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-5- in. w.g.) differential

### **3.2 A2L REFRIGERANT CONTAINING EQUIPMENT**

- .1 A2L refrigerants are classified as mildly flammable. CSA B52-2023 has specific safety clauses related to the use of refrigerants with this classification within buildings.
- .2 This contractor shall be responsible to ensure that the installation requirements of CSA B52-2023 are met.
- .3 Throughout this specification various pieces of equipment have been specified with refrigerant leak detection systems. Field wiring of the alarm status of this system to various downstream system components is required under Annex P of the standard and is the responsibility of this contractor. These devices include the following:
  - .1 Open all zone dampers connected to the affected system.
  - .2 Disable electric reheat coils within the affected system.
  - .3 Activate field installed safety shut off valves on the affected refrigeration systems
  - .4 De-energize any potential sources of ignition with the ductwork system of the affected system.
  - .5 Energize fans within the ductwork system.
  - .6 Activate any designated refrigeration leak ventilation systems.

### **3.3 VERIFICATION OF REFRIGERATION LEAK DETECTION SYSTEM OPERATION**

- .1 The commissioning process shall include the verification of the refrigeration leak detection system.
- .2 All interlocks between leak detection systems installed and system components, as well as interlocks between field installed detection systems and associated safety system components shall be tested and verified to operate as per the requirements of CSA B52. Specifically, the following shall occur for each independent system on registration of a refrigerant leak:
  - .1 Open all zone dampers in the affected system.
  - .2 Disable all electric reheat coils within the affected system.
  - .3 Activate field installed safety shut off valves within the affected refrigeration system.
  - .4 Energize all fans within the affected ductwork system.
  - .5 Activate and refrigerant leak system specific ventilation systems.
  - .6 De-energize any other potential sources of ignition within the affected system.

### **3.4 NAMING OF POINTS AND CONTROLLERS**

- .1 Refer to section 25 05 02 Building Automation Systems – General Requirements

### **3.5 START-UP AFTER POWER FAILURE**

- .1 System shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started; along with the time delay between starts shall be user adjustable.

### **3.6 REQUIREMENTS TYPICAL TO ALL SEQUENCES**

- .1 BAS contractor is responsible to provide a full and complete system that is capable of meeting all sequences, alarms, trends etc. specified. A point not being listed on a points list does not absolve the contractor from providing it if it is necessary to meet the Sequence of Operation.
- .2 All set points, reset curves etc. shall be adjustable by the operator.
- .3 This building is designed to comply with the prescriptive approach of the OBC SB-10 and ASHRAE 90.1 All mandatory control functions listed in the latest edition of ASHRAE 90.1 shall be included in sequences. These functions include, but are not limited to:
  - .1 Zone thermostatic control, complete with dead bands between heating and cooling set points.
  - .2 Set-point overlap protection
  - .3 Off-Hour Controls consisting of:
    - .1 Automatic shut down
    - .2 Temperature set back
  - .4 Optimum start controls
  - .5 Zone Isolation or grouping of HVAC equipment that is not expected to operate on the same schedule. All equipment in a single zone shall be scheduled together unless it was designed to operate 24/7. Each zone shall be capable of being provided it's own schedule or being scheduled together. As per ASHRAE 90.1 a zone shall not span more than one floor or be greater than 25,000 square feet.
  - .6 Provide logic to identify zones that may be excessively driving reset logic and generate an alarm for system operator to review. Provide functionality to remove any zone from reset logic.
  - .7 Where a space has a door to the exterior without an automatic closer, provide a door switch that resets heating set point to 55°F and cooling set point to 90°F if the opening is left open for more than 5 minutes.

### **3.7 ALARMS**

- .1 Provide alarms, alarm hierarchy and alarm suppression as indicated in ASHRAE Guideline 36. Provide an alarm system capable of providing the following:
  - .1 Time and date is listed on the alarm
  - .2 Alarm Level. User shall be able to set alarm level for each individual alarm. The 4 levels of alarm shall be as follows:
    - .1 Level 1: Life-safety message
    - .2 Level 2: Critical equipment message
    - .3 Level 3: Urgent Message
    - .4 Level 4: Normal Message
  - .3 Sort alarms by level in the user interface
  - .4 Provide alarm description
  - .5 Provide equipment tags of units in alarm.

- .6 Provide possible cause of alarm, if detected by fault detection routines.
- .7 User adjustable entry delay for alarms. The default time delays are as follows:
  - .1 Level 1: 1 second
  - .2 Level 2: 10 seconds
  - .3 Level 3: 1 minute
  - .4 Level 4: 5 minutes
- .8 Alarms shall be configured as latching or nonlatching. A latching alarm requires acknowledgement from operators before return to normal, even if exit deadband has been met. A nonlatching alarm does not require acknowledgement. Default latching status is as follows:
  - .1 Level 1 alarms: Latching
  - .2 Level 2 alarm: latching
  - .3 Level 3 alarms: nonlatching
  - .4 Level 4 alarms: nonlatching
- .9 Postexit suppression delay shall be provided to limit the number of alarms. Once an alarm has been triggered and reset it shall not be triggered again for a period of time. Default delay is as follows:
  - .1 Level 1 alarms: 0 minutes
  - .2 Level 2 alarm: 5 minutes
  - .3 Level 3 alarms: 24 hours
  - .4 Level 4 alarms: 7 days
- .10 Hierarchical Alarm Suppression. Provide a mechanism by which alarms in downstream equipment in the hierarchy are not presented to the operator if the source of the error is likely due to an alarm elsewhere in the building. (i.e. do not alarm that a VAV box cannot maintain discharge air temperature if the boiler plant or main circulation pumps are in alarm). Failure to start, Level 1, and command/status mismatch alarms are not subject to this hierarchy.

### 3.8 TRENDS

- .1 Provide Trends as follows:
  - .1 For HVAC Units:
    - .1 Unit/Fan Command and Status
    - .2 Fan Speed
    - .3 Unit Discharge Air Setpoint or Control Valve position
    - .4 Heating/Cooling Status (if applicable)
    - .5 Unit Supply and Return Air Temperatures
    - .6 Return Air CO<sub>2</sub> (if applicable)
    - .7 Paired Exhaust fan command and status (if applicable)
  - .2 For Heating Plants
    - .1 Boiler Plant Command and status
    - .2 Pump Command and status



- .3 Pump speeds
- .4 Supply and Return water temperatures
- .3 Energy Monitoring (Gas, Electric, Water etc.)
  - .1 Useage
- .4 Temperature Sensitive Spaces (Boiler Rooms, IT Rooms, Electrical Rooms)
  - .1 Space Temperature
  - .2 Heating/Cooling Equipment status
- .5 In-floor Heating
  - .1 Slab temperature
  - .2 Slab temperature setpoint
- .6 Unit Heater
  - .1 Unit Command and Status
- .7 Exhaust Fans
  - .1 At owner request
- .8 Misc. Heating Elements
  - .1 At owner request

### **3.9 SCHEDULES**

- .1 All equipment shall be assigned to logical zone groupings of equipment with each group having its own defined schedule.
- .2 Provide a standard schedule complete with options for both holiday and exception schedules for each zone.
- .3 User shall be able to assign multiple zones to the same schedule where appropriate.

### **3.10 ROOM TEMPERATURE SET POINTS**

- .1 Office and Training Room Heating:
  - .1 Occupied: 21° C.
  - .2 Unoccupied: 16° C.
- .2 Office and Training Room Cooling:
  - .1 Occupied: 24° C.
  - .2 Unoccupied: 27° C.
- .3 Apparatus Bay and Antique Truck Room Heating
  - .1 Occupied: 18° C.
  - .2 Unoccupied: 16° C.
- .4 Apparatus Bay and Antique Truck Room Cooling (Fan on Reverse Acting Thermostat)
  - .1 Occupied: 21° C.
  - .2 Unoccupied: 24° C.

- .5 Occupied Standby: **Provide and install Occupancy Sensors** to provide occupancy of space. If unoccupied, set heating set point back 1°F and set cooling set point up 1°F after 5 minutes of unoccupied. If all spaces in an HVAC zone are unoccupied disable HVAC system fans. Lighting integration may be used to determine occupancy of space if this contractor is providing lighting controls.

### **3.11 GLOBAL TERMINAL UNIT INFORMATION DISPLAY**

- .1 The display shall be updated at least once a minute and include the following information:
  - .1 Total number of heat pumps/terminal units in occupied mode.
  - .2 Total number of heat pumps/terminal units in override mode.
  - .3 Total number of heat pumps/terminal units in cooling.
  - .4 Total number of heat pumps/terminal units in heating.
  - .5 Total number of heat pumps/terminal units in alarm.
  - .6 Average Space Temperature
  - .7 Lowest space temperature
  - .8 Average heating offset
  - .9 Greatest heating offset
  - .10 Average cooling offset
  - .11 Greatest cooling offset

### **3.12 OCCUPANCY SENSOR INTEGRATION**

- .1 **BAS shall monitor space occupancy levels for each room via BAS controlled occupancy sensors.**
- .2 Spaces shall be given a temporary unoccupied setback of 1°C from normal set back if the occupancy sensor picks up no occupants for 30 minutes during occupied hours.

### **3.13 Air Source Heat Pump (ASHP) / BOILER PLANT (CONDENSING PRIMARY SECONDARY)**

- .1 General
  - .1 The ASHP/boiler system provides heating hot water for most of the building.
  - .2 Stage 1 hydronic heat is provided by the ASHP system. There is a heat exchanger that allows heat to be injected from the ASHP into the heating loop.
  - .3 Stage 2 hydronic heating: boilers assist ASHP to maintain low-temp heating loop setpoint. Boilers provide heat directly to heating water (no heat exchangers).

- .4 The ASHP is equipped with factory supplied and installed controllers and safeties. The BAS shall provide a hot water supply temperature setpoint to the ASHP, shall enable / disable the ASHP, and shall command on associated pumps when the ASHP system is enabled. (If heat pump system includes integral outputs for pump enable/disable, then boiler system outputs shall be used instead of the BAS points. This contractor to coordinate with mechanical contractor).
- .5 Boilers are equipped with factory supplied and installed controllers and safeties. BAS shall provide a hot water supply temperature setpoint to the boilers. The boiler control panel will then control the staging of the boilers.
- .6 The lead boiler designation will be rotated weekly to equalize runtimes. If the lead boiler should fail, the lag boiler will be started. The lead boiler shall be fired for a scheduled 5 minute test run each week ensure operable condition of equipment.
- .7 The two system pumps will be rotated weekly to equalize runtimes. The lead pump designation shall alternate weekly. If the lead pump should fail, the lag pump will be started after a 15 second delay.
- .8 The boiler circulation pumps shall be controlled by the boiler control system. Pump status shall be monitored.
- .9 The motorized isolation valves on the boilers shall be provided by this contractor but controlled by the integral boiler controls.
- .10 The motorized isolation valve on the ASHP heat exchanger shall be provided by this contractor and controlled by the BAS. (If heat pump system includes integral outputs for isolation valve control, then ASHP system outputs shall be used instead of the BAS points. This contractor to coordinate with mechanical contractor).
- .2 Safeties and Limits
  - .1 Minimum start and stop time delays are provided on all outputs to prevent short cycling of equipment.
  - .2 Boilers have a minimum on time of 5 minutes and off time of 2.5 minutes.
  - .3 If the outdoor air sensor fails, the boiler system will be enabled. The setpoints will set to -5° C outside air temperature.
  - .4 The system pumps will run for 10 minutes after the boilers/ASHP shut down to dissipate heat.
  - .5 The boiler/ASHP circulation pumps shall run for 10 minutes after the boilers shut down to dissipate heat.
  - .6 Control each boilers discharge temperature to ensure it does not cross the high limit of 93.3 degrees C (i.e. limit boiler modulation as discharge temperature approaches high limit).

- .3 ASHP System Start/Stop
  - .1 The system will be enabled whenever any of the following occurs:
    - .1 The outside air temperature is less than 10° C.
    - .2 The outside air temperature is less than 15° C and the building is occupied.
  - .2 The system will be disabled whenever any of the following occur:
    - .1 There are no heat-requests from the building and the outside air temperature rises above 18° C for more than 30 minutes.
    - .2 There are no heat requests from the building and the outside air temperature rises above 10° C for more than 1 hour and the building is unoccupied.
    - .3 Hydronic system enters high temperature heating mode.
  - .3 When the system is enabled the ASHP heat exchanger pumps shall operate continuously.
- .4 Boiler System Start/Stop
  - .1 The system will be enabled in low-temperature heating mode whenever any of the following occurs:
    - .1 The outside air temperature is less than 10° C and primary loop temperature is more than 5° C below setpoint.
  - .2 High-temp heating mode will be enabled in stages whenever any of the following occurs:
    - .1 The outside air temperature is less than 5° C and any single space setpoint remains unmet for more than 30 minutes.
    - .2 The outside air temperature is less than 0° C and any single space setpoint remains unmet for more than 5 minutes.
    - .3 Return water temperature is less than 32°C.
  - .3 High-temp heating mode will be disabled in stages whenever any of the following occur:
    - .1 All space setpoints have been met for more than 30 minutes.
  - .4 High-temp heating mode enable/disable sequence:
    - .1 Enable: shut off ASHP system and increase loop temperature by 5°C. Increase loop temperature again by 5°C every 5 minutes until all requirements for entering high-temp heating mode have been satisfied.
    - .2 Disable: when all space and loop setpoints have been met for more than 30 minutes, decrease loop setpoint by 5°C. Continue decreasing loop setpoint by 5°C every 30 minutes as long as space and loop setpoints are met. Re-enter low-temp heating mode when loop temperature drops below 50°C.
- .5 Control Strategy
  - .1 Heating will be enabled once pump status is confirmed.

- .2 HWS temperature (low-temp heating mode) shall be reset based on a two point curve of outdoor air. High-temp heating mode will follow stepped increase/decrease in HWS temperature to a maximum of 66 °C. Loop temperatures summarized according to following schedule:

Primary Loop Temperature	Outdoor Air Temperature
66°C (Maximum)	High-Temp Heating Mode
49°C	0°C
43°C	18°C

- .3 The outdoor air reset schedule will shift up or down to satisfy the heating requests from the system and the set point will be adjusted between a minimum of 43 and a maximum of 66 degrees C.
- .4 If heating PID output is greater than 80%, lag boiler circulator pump shall start. Once pump status is confirmed both boilers shall modulate in unison to maintain set point. On-board cascading boiler control with similar sequence is also acceptable.
- .5 If heating PID output drops below 40%, lag boiler is disabled. Lag pump shall disable after 10 minute time delay to dissipate excess heat. On-board cascading boiler control with similar sequence is also acceptable.
- .6 Boilers shall be staged to bring on second boiler once first boiler reaches 50% firing (i.e. both boilers shall fire at 25% then modulate up together). The next boiler shall be brought on once both running boilers are at 50%, then all three boilers shall modulate together. This approach shall continue until all boilers in the system are firing.
- .6 Pressure Control
- .1 The BAS shall control the pump VFD set point to maintain the system pressure set point.
- .2 Pressure set point reset shall be provided to maximize energy savings. Reset shall use a PID loop based on valve commands in the system.
- .3 If the system differential is below set point and pump on high speed for more than 15 minutes, the lag pump starts. If both pumps are on and the system differential pressure is at set point and the pumps are on high speed for more than 15 minutes the lag pump is stopped.
- .4 Minimum flow rate bypasses through mixing valve in in-floor heating manifolds.
- .7 An alarm for the following shall be generated on the BAS:
- .1 ASHP status is received and associated heat exchanger pump(s) status is off or the ASHP is commanded off.
- .2 ASHP status is not received and the ASHP is command is on (5 minute delay).
- .3 ASHP alarm contact indicates ASHP is in alarm.

- .4 Boiler status is received and its primary pump status is off or the boiler is commanded off.
- .5 Boiler status is not received and the boiler command is on (5 minute delay).
- .6 Boiler alarm contact indicates boiler is in alarm.
- .7 Pump status is received and the command is off (10 minute delay).
- .8 Pump status is not received and the command is on, or status and command mismatch (5 minute delay).
- .9 The heating system is on and the primary supply water temperature is more than 10 degrees from setpoint (10 minute delay).
- .10 An alarm will be generated with the outdoor temperature is below 4° C and the boiler return water temperature is below 27° C.
- .11 An alarm will be generated if any space temperature is below 5° C.
- .12 An alarm will be generated if the boiler loop pressure sensor drops below an adjustable threshold.
- .13 System differential pressure deviates from set point.

.8 Points List

Name	AI	AO	DI	DO
ASHP Command				X
ASHP Status			X	
ASHP Alarm			X	
ASHP HX Circulator Command *				X
ASHP HX Circulator Status	X			
ASHP HX Isolation Valve Command *				X
Boiler Command				X
Boiler Status			X	
Boiler Alarm			X	
Boiler Isolation Valve Command **		X		
Boiler Circulator Command **				X
Boiler Circulator Status	X			
System Pump(s) Command				X
System Pump(s) Status	X			
System Pump(s) Alarm			X	
System Pump(s) Speed Modulation		X		

Differential Pressure Set Point		X		
Differential Pressure Reading	X			
Hot Water Supply Temperature	X			
Hot Water Return Temperature	X			
Boiler Discharge Temperature	X			
Hot Water Supply Temperature Set Point		X		

.9 Notes:

- .1 (\*) This point by controls contractor unless explicitly coordinated with mechanical contractor for install by mechanical contractor.
- .2 (\*\*) This point is provided by boiler controller for control of boiler pump or boiler isolation valve.

### 3.14 IN-FLOOR HEATING LOOP CONTROL

.1 General

- .1 The in-floor heating loops are served by packaged in-floor heating manifolds complete with a four-way valve mixing valve, circulation pump, and a slab temperature sensor.

.2 Safeties and Limits

- .1 Manifold pump shall shut off if supply water temperature downstream of mixing valve exceeds maximum 50° C setpoint to avoid damage to floor slab.

.3 System Start/Stop

- .1 The in-floor perimeter heating loop pumps shall operate whenever the ASHP or boiler system is operating.

.4 Control Strategy

- .1 When ASHP or boilers are enabled, and pump status is received, the mixing valve will modulate to maintain the in-floor loop supply water temperature setpoint. In-floor loop supply water temperature setpoint will be reset to maintain slab temperature setpoint.
- .2 Slab temperature setpoint will be reset upon outdoor air temperature. Use the following reset curve:
  - .1 OAT < 10°C then slab setpoint = 27°C (81°F)
  - .2 10°C < OAT < 15°C then slab setpoint = 24°C (75°F)
  - .3 15°C < OAT then no heat to slab
- .3 Zones 2, 3, and 4 are served by the same mixing valve and pump. For these three zones the supply water temperature will remain constant, and the zone valves will modulate to maintain slab temperature. Supply water temperature shall only reset down if slab temperature is met in all three zones.

- .4 The manifold serving zones 2, 3, and 4 includes a constant speed pump and three zones with 2 way temperature control valves. This zone manifold shall also be complete with a bypass valve. The differential pressure bypass valve will modulate to maintain pressure differential between supply and return lines to set point. Coordinate setpoint with balancer.
- .5 An alarm for the following shall be generated on the BAS:
  - .1 Pump start/stop/status mismatch (10 minute delay)
  - .2 Low differential pressure alarm (10 minute delay) (Zone 2, 3, 4 only)
  - .3 High differential pressure alarm (10 minute delay) (Zone 2, 3, 4 only)
  - .4 Reset slab temperature down to 18°C (65°F) if overhead doors are opened for more than 5 minutes.
- .6 Turn off training room heating zone if AHU-1 is in cooling mode.
- .7 Reset
- .8 Points List

Name	AI	AO	DI	DO
Zone Pump(s) Command				X
Zone Pump(s) Status	X			
Slab Temperature Setpoint		X		
Slab Temperature Reading	X			
Supply Water Temperature Setpoint		X		
Supply Water Temperature Reading	X			
Control valve modulation		X		
Differential Pressure Reading (Zone 2, 3, 4 manifold only)	X			
Bypass Valve Modulation(Zone 2, 3, 4 manifold only)		X		

### 3.15 UNIT HEATERS

- .1 A temperature sensor energizes the fan to maintain setpoint. Fan status is monitored and alarms to BAS when it does not match command.
- .2 Temperature sensor shall also modulate associated Temperature Control Valve
- .3 The control system shall maintain the following temperatures:
  - .1 18°C for Bunker Room
  - .2 13°C for Apparatus Bay and Antique Truck Room.
- .4 Provide alarm if space temperature is below 10°C.
- .5 Reset temperature setpoint to 15°F if door is opened for more than 5 minutes. Relay signal to in-floor heating system.



.6 Points List

Name	AI	AO	DI	DO
Space Temperature	X			
Temperature Control Valve Modulation		X		
Fan Command				X
Fan Status	X			
Door Switch	X			

**3.16 SPLIT SYSTEM AIR-HANDLING UNIT**

.1 General

- .1 The split system air handling unit consists of a pre-filter, DX cooling/heating coil, remote condensing unit / heat pump, modulating electric post-heat (duct heater), and supply fan. The unit is self contained and controls to space air temperature provided to the unit from the DDC system.

.2 Limits and Safeties

- .1 Unit shall be equipped with a freeze stat.
- .2 Mechanical cooling low temperature protection: If the outdoor air temperature falls below its Mechanical Cooling Lockout setpoint, it will prevent the mechanical cooling stages from being energized.
- .3 Monitor units' refrigeration leak detection system. Upon signal from system :
- .1 Disable any electric reheat or other sources of ignition in the ductwork system.
  - .2 Fully open zone dampers within the ductwork system/close bypasses.
  - .3 Energize all fans within the duct system/general exhaust fans in area affected.

.3 Unit Start/Stop

- .1 Occupied Mode: unit fan runs continuously.
- .2 Unoccupied Mode: unit fan is off unless there is requirement for space heating and cooling.

.4 Control Strategy

- .1 Space Temperature Control
- .1 Room Temperature Control: the DX cooling and heating stage(s) and electric post-heat will be activated appropriately to maintain the supply air temperature at its setpoint.

- .2 Unoccupied Mode: When the room temperature falls below the unoccupied low limit setpoint, then the HVAC unit will start and continue to run until the room temperature rises by 3C°. If the room temperature rises above the unoccupied high limit setpoint, then the unit will start and continue to run until the room temperature falls by 3C°. Unit shall operate at full heat or cooling to bring space to setpoint as quickly as possible. Provide minimum run times as per Occupied mode. If supplemental heat is available (in-floor heating), it shall be first stage heat.
- .2 Supply Fan Shutdown Delay: If the fan system is shut down while heating or cooling stages are energized, the stages will immediately de-energize and the fan will continue to run for a set cool down or warm down period, then shut down.
- .3 Ventilation Control
  - .1 The ERV shall be enabled during all occupied hours periods to provide minimum ventilation rate. The ERV shall utilize free cooling when conditions are suitable.
  - .2 Provide CO<sub>2</sub> controls to override ERV fan speed controls to allow more outside air to enter. Maintain CO<sub>2</sub> at 900 ppm (adj). Limit ERV fan speed to prevent MAT falling below 13 degrees C.
- .5 Alarms
  - .1 Fan System Failure Alarm: An alarm is generated whenever the supply fan fails to respond to start-stop commands.
  - .2 Unit not cooling when commanded, as indicated by SAT (5 minute delay)
  - .3 Unit not heating when commanded, as indicated by SAT (5 minute delay)
  - .4 Supply air temperature above 35°C (5 minute delay)
  - .5 Unit is running and return air CO<sub>2</sub> levels are above 800 ppm (1 hour delay)
- .6 Points List
  - .1 Where available, points may be integrated via BACNet. Any points not available via BACNet shall be provided by this contractor.

Name	AI	AO	DI	DO
Space Temperature	X			
Space Temperature Setpoint or Adjustment	X			
Unit Command				X
Unit Status	X			
Entering (Mixed) Air Temperature	X			
Supply Air Temperature	X			
Return Air CO <sub>2</sub> (See ERV sequence)	X			
Return Air Temperature	X			
Freeze Stat Status			X	
Unit Alarm			X	

### 3.17 MULTI-SPLIT VRF SYSTEM

#### .1 General

- .1 The split system air handling unit consists of a pre-filter, DX cooling/heating coil, remote condensing unit / heat pump, modulating electric post-heat (duct heater), and supply fan. The unit is self contained and controls to space air temperature provided to the unit from the DDC system.

#### .2 Limits and Safeties

- .1 Monitor units' refrigeration leak detection system. Upon signal from system:  
.1 Energize all fans within the duct system/general exhaust fans in area affected.

#### .3 Unit Start/Stop

- .1 System remains enabled continuously. System operates to maintain space temperature.

#### .4 Control Strategy

- .1 Space Temperature Control  
.1 Room Temperature Control: multi-split system operates based on supplier provided temperature sensors to maintain space setpoint.  
.2 System controller is BACnet compatible. Map room temperatures, equipment status, and alarms to BAS system.

#### .5 Points List

- .1 Where available, points may be integrated via BACNet. Any points not available via BACNet shall be provided by this contractor.

Name	AI	AO	DI	DO
Space Temperature	X			
Space Temperature Setpoint or Adjustment	X			
Unit Status	X			
Entering (Mixed) Air Temperature	X			
Supply Air Temperature	X			
Return Air CO <sub>2</sub> (See ERV sequence)	X			
Return Air Temperature	X			
Freeze Stat Status			X	
Unit Alarm			X	

### 3.18 ELECTRIC DUCT HEATERS

#### .1 General

- .1 Electric duct heaters simply maintain minimum supply air temperature in ductwork except for duct heater that is interlocked directly to air-handling unit. Supply air temperature in ductwork is reset per outdoor air temperature.

- .2 Limits and Safeties
  - .1 Provide airflow sensing or confirmation of fan motor initiation where duct heaters do not have integral air-flow proving safety.
  - .2 Electric duct heaters have integral high temperature cutout and other standard safeties.
- .3 Unit Start/Stop
  - .1 Enable duct heater when outdoor air temperature is below 15°C. Disable duct heaters when outdoor air temperature is above 15°C.
- .4 Control Strategy
  - .1 Electric duct heater serving office multi-split heads shall modulate to maintain 10°C supply air temperature.
  - .2 Electric duct heater providing supply air to washrooms and corridors shall modulate (when enabled) to maintain 20°C supply air temperature.
  - .3 Electric duct heater connected to AHU-1 shall be controlled through AHU-1 controls to maintain room setpoint.
- .5 Points List

Name	AI	AO	DI	DO
Heater Enable / Disable				X

### 3.19 EXHAUST FANS (CO/NOX)

- .1 Start/stop exhaust fans based on CO/NOX sensor and control panel.
- .2 The DDC system monitors the CO/NOX panel for status and alarm. DDC system generates an alarm if CO/NOX panel indicates alarm.
- .3 CO/NOX panel controls fan directly. Wire the motor starter control through the 15% open contact point on the damper actuator to ensure that dampers are partially open prior to fan start. Or provide time delay on fan starter to ensure partial damper opening before fan start.
- .4 Monitor fan status. Indicate alarm on BAS if fan status does not match fan command as read from CO/NOX panel.
- .5 Points List

Name	AI	AO	DI	DO
CO/NOX Status	X			
CO/NOX Alarm			X	
Exhaust Fan Status	X			
Motorized Damper Command *				X*
Motorized Damper Feedback *			X*	

\* Motorized damper command/feedback is not required as a point on the BAS where fan starter is wired directly through the damper actuator 15% open contact point.

### 3.20 EXHAUST FANS (HEAT REJECTION)

- .1 Start/stop exhaust fans based on space temperature.
- .2 The space temperature shall be indicated on the BAS.
- .3 Exhaust fan shall operate with motorized dampers on the exhaust ductwork, and on the make up air ductwork if motorized dampers are indicated on the plans. Ensure dampers are partially open prior to fan start.
- .4 Monitor fan status. Indicate alarm on BAS if fan status does not match fan command.
- .5 Points List

Name	AI	AO	DI	DO
Exhaust Fan Command				X
Exhaust Fan Status	X			
Space Temperature	X			
Motorized Damper Command *				X*
Motorized Damper Feedback *			X*	

\* Motorized damper command/feedback is not required as a point on the BAS where fan starter is wired directly through the damper actuator 15% open contact point.

### 3.21 EXHAUST FANS (COMBINATION CO/NOX & HEAT REJECTION)

- .1 Control Start/stop exhaust fans based on parallel control: CO/NOX panel and space temperature. Fan on when CO/NOX or space temperature calls on. Fan off only when both sensors call for fan to be off.
- .2 The space temperature shall be indicated on the BAS.
- .3 Exhaust fan shall operate with motorized dampers on the exhaust ductwork, and on the make up air ductwork if motorized dampers are indicated on the plans. Ensure dampers are partially open prior to fan start.
- .4 Monitor fan status. Indicate alarm on BAS if fan status does not match fan command from CO/NOX panel or from reverse acting thermostat.
- .5 Points List

Name	AI	AO	DI	DO
CO/NOX Status	X			
CO/NOX Alarm			X	
Exhaust Fan Command				X
Exhaust Fan Status	X			
Space Temperature	X			
Motorized Damper Command *				X*
Motorized Damper Feedback *			X*	

\* Motorized damper command/feedback is not required as a point on the BAS where fan starter is wired directly through the damper actuator 15% open contact point.

### 3.22 ENERGY RECOVERY VENTILATOR

- .1 General
  - .1 ERV shall be integrated via Terminal Strip
  - .2 ERV shall come with internal controller to control wheel modulation speed, fan status, free cooling and defrost cycles.
- .2 Safeties and Limits
  - .1 Unit shall be prevented from short cycling by the BAS.
- .3 Start/Stop
  - .1 The unit shall be started and stopped by occupancy sensors in the offices, training room, and washrooms. Unit shall start on low speed (half of total design volume).
- .4 Speed Modulation
  - .1 The unit shall modulate fan speed to maintain maximum 800 ppm CO2 in Training Room.
  - .2 The unit shall modulate fan speed to maintain maximum 50% RH in the washrooms / shower rooms.
- .5 Control Strategy
  - .1 The unit shall utilize internal controls.
  - .2 BAS shall direct ERV to enter free cooling bypass mode if outdoor air is between 10°C and 18°C and indoor spaces are calling for cooling.
- .6 Alarms
  - .1 Provide indication at OWS if unit is in alarm.
  - .2 If fan status does not match command. (10 minute delay)
- .7 Points List
  - .1 Where available, points may be integrated via BACNet. Any points not available via BACNet shall be provided by this contractor.

Name	AI	AO	DI	DO
Unit Command				X
Fan Speed (Hi/Med/Low)				X
Supply Fan Status	X			
Exhaust Fan Status	X			
Unit Alarm			X	
ERV Wheel Status	X			
ERV Wheel Entering Air Temp	X			
ERV Wheel Leaving Air Temp	X			
Occupancy Status			X	
Training Room CO2	X			
Washroom Relative Humidity	X			

### 3.23 DOMESTIC WATER SYSTEM CONTROL (BOILERS)

- .1 Electric heating elements maintain tank aqua stat setpoint.
- .2 Cycle start/stop/modulate boilers to maintain domestic hot water supply setpoint at aqua stat located downstream of hot water heaters (tanks). Aqua stat setpoint for boilers is intentionally lower than setpoint for electric hot water heaters.
- .3 Cycle domestic water circulation pump with boiler, provide a 60-second (adj) delay shutdown from boiler.
- .4 Provide start/stop/status on pump
- .5 Provide indication of supply temperature to each domestic hot water loop and in each storage tank.
- .6 Pump status shall be monitored.
- .7 Alarms shall be provided for the following:
  - .1 Recirc or boiler circulation pump start/stop/status mismatch (5 minute delay).
  - .2 Domestic hot water supply temperature rises above 45 degrees C for main building loop.
  - .3 Domestic hot water boiler is in alarm state.
- .8 Points List (BACnet integration to boiler system controller is permitted where available)

Name	AI	AO	DI	DO
Supply Water Temperature (for boilerloop)	X			
Recirc Pump Command (Boiler Controller)				X
Recirc Pump Status	X			
Hot Water Boiler(s) Command (Boiler Controller)				X
Hot Water Boiler(s) Modulation (Boiler Controller)	X			
Hot Water Boiler(s) Alarm			X	
Hot Water Boiler(s) Circulation Pump Command (Boiler Controller)				X
Hot Water Boiler(s) Circulation Pump Status (Boiler Controller)	X			
Storage Tank Temperature (multiple)	X			

### 3.24 IT ROOM TEMPERATURE CONTROL

- .1 General
  - .1 The BAS shall control the IT room cooling system.

.2 Limits and Safeties

- .1 The discharge air temperature from the indoor fan coil unit shall be maintained above 10°C.
- .2 Monitor dry-chemical fire suppression system. Upon signal from system:
  - .1 Fully close zone dampers within the ductwork system.
  - .2 Disable all fans within the duct system/general exhaust fans in area affected.

.3 Control Strategy

- .1 The BAS shall provide a temperature and humidity set-point to the unit to maintain.
- .2 Unit controls shall control unit operation to maintain set point. BAS contractor shall be responsible for commissioning and set up of equipment.
- .3 Provide space temperature and humidity sensor that is separate from unit sensors.
- .4 Provide graphic indicating status of all heating, cooling, fans, reheat and discharge air temperature and humidity.

.4 Alarms

- .1 Monitor all unit alarms.
- .2 Alarm if space temperature rises 3°C above set point.

.5 Points List

- .1 Where available, points may be integrated via BACNet. Any points not available via BACNet shall be provided by this contractor.

Name	AI	AO	DI	DO
Unit Command				X
Space Temperature Set Point		X		
Space Humidity Set Point		X		
Unit Alarm			X	
Space Temperature	X			
Space Humidity	X			
Unit Fan Status	X			
Unit Heat/Cool/Reheat Status			X	
Unit Discharge Air Temperature	X			
Unit Discharge Air Humidity	X			



### 3.25 BUNKER ROOM TEMPERATURE AND HUMIDITY CONTROL

#### .1 Room Temperature Control.

The room temperature control consists of a temperature sensor, a humidity sensor, in-floor heat modulating control valve, a forced flow unit heater fan motor and modulating control valve, an electric heater, an exhaust air fan and a motorized damper. The room also has an electric unit heater not connected to the BAS. The electric unit heater is to control to a lower setpoint and is in place as a backup to maintain space temperature. The DDC will control using electric actuation.

The controller monitors the room temperature sensor and the room humidity sensor.

On a call for cooling the in-floor heating control valve is closed, the unit heater control valve is closed and the fan motor is off, controller will open the motorized damper and start exhaust fan motor to maintain room temperature setpoint.

On a call for dehumidification the controller will open the motorized damper and start exhaust fan motor to maintain room temperature setpoint. The controller will modulate in-floor heating control valve, hydronic unit heater control valve and fan to maintain setpoint.

The DDC system uses current switches to confirm fan operation. Provide a dual voltage relay adjacent to the BAS panel. DDC system generates an alarm if status deviates from DDC start/stop control.

#### .2 Points List

Name	AI	AO	DI	DO
Space Temperature	X			
Space Humidity	X			
Exhaust Fan Command				X
Exhaust Fan Status	X			
Damper Command				X
Damper Status	X			
In-Floor Heating Valve Modulation		X		
Unit Heater Fan Command				X
Unit Heater Fan Status	X			
Unit Heater Valve Modulation		X		

### 3.26 EXTRACTION ROOM TEMPERATURE AND HUMIDITY CONTROL

#### .1 Room Temperature Control.

The room temperature control consists of a temperature sensor, a humidity sensor, in-floor heat, an exhaust air fan and a motorized damper.

The controller monitors the room temperature sensor and the room humidistat.

On a call for cooling or dehumidification, the controller will open the motorized damper and start exhaust fan motor to maintain room temperature and humidity setpoints.

The DDC system uses current switches to confirm fan operation. Provide a dual voltage relay adjacent to the BAS panel. DDC system generates an alarm if status deviates from DDC start/stop control.

.2 Points List

Name	AI	AO	DI	DO
Space Temperature	X			
Space Humidity	X			
Exhaust Fan Command				X
Exhaust Fan Status	X			
Damper Command (if applicable)				X
Damper Status (if applicable)	X			

**3.27 OUTDOOR TEMPERATURE AND HUMIDITY**

- .1 Provide new sensor for outdoor air temperature  
.2 Provide new sensor for outdoor humidity  
.3 Points List

Name	AI	AO	DI	DO
Outdoor Air Temperature	X			
Outdoor Air Humidity	X			

**3.28 EXTERIOR LIGHTING CONTROL**

- .1 The outdoor lighting consists of two lighting zones (parking lot poles and wall packs) and one astrological clock.  
.2 The DDC will control using electric actuation Start/stop of each lighting zone on time of day schedule. Photocell will override program turning lights on should outdoor elements reach a low illumination during program stop period.  
.3 The DDC system will monitor lighting zone operation and generates an alarm if status deviates from DDC start/stop control.  
.4 Points List

Name	AI	AO	DI	DO
Zone Command (multiple)				X
Photocell			X	
Astrological Clock			X	

**3.29 ELECTRICAL/GAS/WATER METER INTEGRATION**

- .1 Integrate electrical meters provided as part of switchboard into BAS to provide monitoring of instantaneous electrical load, as well as a variety of totalization and trending.

- .2 Provide meters to monitor gas and domestic water usage as indicated on drawings.  
Connect also to utility grade meters for bulk monitoring and trending.
- .3 Co-ordinate exact method of integration with electrical trade.
- .4 Points List

Name	AI	AO	DI	DO
Electrical Use	X			
Gas Use	X			
Water Use	X			

### 3.1 WARRANTY

- .1 Warranty Start Date:
  - .1 Warranty period starts as of the date of Ready for Takeover.
  - .2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.
- .2 Warranty Duration:
  - .1 Two (2) year warranty period applies.
- .3 Warranty Coverage:
  - .1 Applies to parts and labour.

**END OF SECTION**

## **Division 26 Common Requirements for Electrical**

26 00 11	Electrical Specification Index
	<b>Common Contract Requirements for Electrical</b>
26 01 13	Electrical Supplemental Tender Form
26 01 16	Electrical Contract General Requirements
26 01 20	Integrated Testing of Fire Protection and Life Safety Systems
	<b>Common Work Results for Electrical</b>
26 05 19	Wires and Cables
26 05 20	Junction and Pull Boxes
26 05 21	Outlet Boxes, Conduit Boxes and Fittings
26 05 22	Wire and Box Connectors – 0 –1000 V
26 05 26	Grounding Secondary
26 05 27	Seismic Restraint for Electrical Systems
26 05 33	Conduits, Conduit Fastenings and Conduit Fittings
26 05 43	Installation of Cables in Trenches and Ducts
26 05 74	Short Circuit/Coordination Study Arc Flash Hazard Analysis
26 05 75	Auxiliary Systems
26 05 76	Electric Heating Systems
	<b>Low-Voltage Transformers</b>
26 22 13	Dry Type Transformers
	<b>Switchboard and Panelboards</b>
26 24 13	Service Entrance Board
26 24 16	Panelboards
26 24 17	Moulded Case Circuit Breakers
	<b>Low-Voltage Distribution Equipment</b>
26 27 26	Wiring Devices
	<b>Low-Voltage Circuit Protective Devices</b>
26 28 13	Fuses – Low Voltage
26 28 16	Disconnect Switches
	<b>Low-Voltage Controllers</b>
26 29 13	Starters and Contactors
	<b>Packaged Generator Assemblies</b>
26 32 16	Power Generation – Natural Gas
	<b>Automatic Transfer Switch</b>
26 36 23	Automatic Transfer Switch
	<b>Electrical and Cathodic Protection</b>
26 43 13	Surge Protective Devices
	<b>Lighting</b>
26 51 13	Lighting Equipment
26 51 16	Digital Occupancy & Daylight Control Systems

## **Division 27 Communications**

<b>Information Technology - Computer Systems</b>
Appendix A – County of Brant Network Infrastructure Design Standards

27 31 40      **Voice Communications Switching and Routing Equipment**  
Telecommunication Network Installations

## **Division 28      Electronic Safety and Security**

28 31 25      **Fire Detection and Alarm**  
Fire Alarm System (Addressable)

**END OF SECTION**

**Part 1 General**

**1.1 INSTRUCTIONS TO BIDDERS**

- .1 The Electrical Supplemental Tender Form must be submitted to the architect and consultant (admin@deiassociates.ca) within 2 hours of tender closing. Electrical contractors shall identify all sub-contractors he/she intends to use and must complete all information requested. The requisite information shall be given at the office of the Consultant. Contractor shall sign and date this page and initial and date each page thereafter.
- .2 Should the Electrical Supplemental Form not be submitted then the contractor shall use Basis of Design manufacturers as listed.
- .3 CONTRACTOR

I/We certify that I/We have the authority to bind the company.

\_\_\_\_\_  
COMPANY NAME

\_\_\_\_\_  
AUTHORIZED SIGNATURE

\_\_\_\_\_  
ADDRESS

\_\_\_\_\_  
PRINTED SIGNATURE

\_\_\_\_\_  
CITY

\_\_\_\_\_  
TITLE

\_\_\_\_\_  
TELEPHONE NUMBER

\_\_\_\_\_  
DATE

\_\_\_\_\_  
FAX

- .4 SUB-CONTRACTORS  
The Contractor shall state below the name of the Public Address, Security, Co-ordination Study, Computer Network, Life Safety Systems Commissioning Agent Sub-contractor he intends to use, which shall not be changed without the consent of the Consultant.  
Co-ordination Study \_\_\_\_\_  
Computer Network \_\_\_\_\_  
Life Safety Systems Commissioning Agent \_\_\_\_\_
- .5 The Stipulated Bid Sum shall be for the basis of design manufacturer or supplier equipment only, unless otherwise indicated. Where a choice of this equipment is given, this Contractor shall indicate the supplier or manufacturer he intends to use. Where no choice is indicated, the basis of design supplier or equipment shall be used.

CONTRACTOR'S NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

- .6 Equipment or materials manufactured by firms named in the following listing only shall be deemed equal to the equipment or material specified, provided the equipment or material will have capacity, performance, rating, construction, physical dimensions, accessories and features which, in the opinion of the Consultant, are equal to those of the specified equipment or material. The Electrical Contractor shall not indicate equipment, materials or suppliers which are not listed.
- .7 Where modifications to the work of other trades are required as a result or part of the alternative offered, include the cost of said modifications in the work.
- .8 Submit the following list of basis of design and alternative suppliers in accordance with the bid requirements:

Spec. Reference Section	Equipment	Basis of Design	Acceptable Alternate Manufacturer	Indicate Manufacturer Or Supplier
26 29 13.13	Starters and Contactors	Schneider Electric	Allen Bradley Siemens Eaton Klockner-Moeller	
26 32 15	Generator	Generac	Onan/Cummins Kohler Caterpillar Paramount	
26 32 15	Transfer Switch	Eaton	Onan/Cummins Asco Thomson Technology	
26 22 13.13	Dry –Type Transformers	Hammond	Rex Acme Delta Bemag	
26 24 13	Service Entrance Board	Schneider Electric	Siemens Eaton	
26 24 17	Molded Case Circuit Breakers	Schneider Electric	Siemens Eaton	
26 28 16	Disconnect Switches	Schneider Electric	Siemens Eaton	
26 24 16	Panelboards	Schneider Electric	Siemens Eaton	

CONTRACTOR'S NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

26 28 13	Fuses – Low Voltage	Mersen	GEC Littlefuse	
26 51 13	LED Interior	Cooper	Lithonia Visioneering Signify	
26 51 13	LED Exterior	Cooper	Lithonia Signify	
26 51 13	Exit Lighting	Aimlite	Lumacell Stanpro	
26 51 13	Emergency Battery Units	Aimlite	Lumacell Stanpro	
26 51 13	Emergency Fixtures	Aimlite	Lumacell Stanpro	
26 05 76	Electric Heating Equipment	Ouellet	Westcan Stelpro	
28 31 25	Fire Alarm System (Addressable)	Edwards	Simplex Notifier Siemens Mircom	

.9 LABOUR RATES

- .1 The following labour rates shall apply for calculating the cost of credit or extras on Change Notices. The rates shall include any employee benefits. The labour rates do not include overhead and profit.

Apprentice Electrician \$\_\_\_\_\_/hr  
Journeyman Electrician \$\_\_\_\_\_/hr

CONTRACTOR'S NAME: \_\_\_\_\_ DATE: \_\_\_\_\_



**1.2 ELECTRICAL TENDER PRICE (EXCLUDING HST)**

- .1 Having carefully examined all Drawings and Specifications and the Addenda to the Drawings and Specifications, and having carefully examined the sites and all conditions affecting the work, we, the undersigned thereby offer to provide all plant, labour, materials and incidentals required to complete the work of all trades for: All the work specified for herein for  
the Total Stipulated Price of: \$\_\_\_\_\_

\_\_\_\_\_  
(in writing)

in lawful money of Canada; included in which are all applicable excise taxes, custom duties, freight, exchange, and all other charges. HST is not included.

**END OF SECTION**

CONTRACTOR'S NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

**Part 1 General**

**1.1 GENERAL**

- .1 This Section covers items common to Electrical Division 26, as well as Division 27 and Division 28.**
- .2 This section supplements requirements of Division 1.
- .3 Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.

**1.2 INTENT**

- .1 Mention herein or indication on Drawings of articles, materials, operations, or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and, performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for electrical work.
- .2 Where used, words “Section” and “Division” shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.
- .3 Where used, word “supply” shall mean furnishing to site in location required or directed complete with accessory parts.
- .4 Where used, word “install” shall mean secured in place and connected up for operation as noted or directed.
- .5 Where used, word “provide” shall mean supply and install as each is described above.

**1.3 TENDERS**

- .1 Complete Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of tender documents.
- .2 Submit Supplemental Tender Form as noted.
- .3 Submit tender based on specified described equipment or Alternates listed.
- .4 State in Tender, names of all Subcontractors proposed for work under this Division.

**1.4 LIABILITY INSURANCE**

- .1 This contractor must maintain and produce at the request of the consultant proof of proper insurance to fully protect the owner, the consultant and the contractor from any and all claims due to accidents, misfortunes, acts of God, etc.

**1.5 ELECTRICAL SAFETY AUTHORITY**

- .1 The contractor is to determine general inspection fees with Electrical Safety Authority and include as part of tender.

- .2 A submission has been made (if required by this scope of project) by the consultant to the Electrical Safety Authority for review of this project. The payment of the required review costs will be coordinated by the consultant. A copy of the Electrical Safety Authority review report will be forwarded to the successful contractor for information and action. Contractor will not be responsible for these review costs.

## **1.6 DRAWINGS**

- .1 Electrical Drawings do not show structural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes or additions to runs of conduits and ducts to accommodate structural conditions. Location of conduits and other equipment may be altered by the consultant without extra charge provided change is made before installation and does not necessitate major additional material.
- .2 As work progresses and before installing fixtures and other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings or obtain directions for exact location of such equipment and fitments.
- .3 Electrical drawings are diagrammatic. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Conceal wiring, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.
- .4 Before commencing work, check and verify all sizes, locations, grades, elevations, levels and dimensions to ensure proper and correct installation. Verify existing/municipal services.
- .5 Locate all electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.
- .6 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install services so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.
- .7 Relocate equipment and/or material installed but not coordinated with work of other Sections as directed, without extra charge.
- .8 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

## **1.7 INTERFERENCE AND COORDINATION DRAWINGS**

- .1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the constructed spaces provided.
- .2 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.

- .3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.
- .4 Upon consultant's request submit copies of interference drawings to the consultant.
- .5 Due to the nature of the building and the complexity of the building systems provide the following:
  - .1 Interference drawings, showing coordination of architectural, structural, mechanical, and electrical systems for the consultant's review prior to fabrication.
  - .2 Detailed equipment room drawings clearly showing all distribution equipment.
  - .3 Detailed layout drawings clearly showing conduit/feeder runs 78mm diameter or larger, including hangers or tray.
- .6 Provide CAD drawings (minimum file version AutoCAD 2013) in addition to hard copies.

## **1.8 QUALITY ASSURANCE**

- .1 The installations of the division must conform to the latest edition of the Electrical Safety Code as well as its supplemental bulletins and instructions. Provide materials and labour necessary to comply with rules, regulations, and ordinances.
- .2 Complete underground systems in accordance with CSA C22.3 No. 7-94 except where specified otherwise.
- .3 Abbreviations for electrical terms: to CSA Z85-1983.
- .4 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify consultant in writing of such differences.

## **1.9 ALTERNATES AND SUBSTITUTIONS**

- .1 Throughout these sections are lists of "Alternate Equipment" manufacturers acceptable to consultant if their product meets characteristics of specified described equipment.
- .2 Each bidder may elect to use "Alternate Equipment" from lists of Alternates where listed. Include for any additional costs to suit Alternated used. Prices are not required in Tender for Alternates listed. Complete the Supplementary Tender Form.
- .3 When two or more suppliers/manufacturers are named in the Bid Documents, only one supplier/manufacture of the products named will be acceptable; however, it is the responsibility of this Division to ensure "Alternate Equipment" fits space allocated and gives performance specified. If an "Alternate Equipment" unit is proposed and does not fit space allotted nor equal specified product in consultant's opinion, supply of specified described equipment will be required without change in Contract amount. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.
- .4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.

## **1.10 EXAMINATION**

- .1 Site Reviews
  - .1 Examine premises to understand conditions, which may affect performance of work of this Division before submitting proposals for this work.
  - .2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- .2 Drawings:
  - .1 Electrical Drawings show general arrangement of fixtures, power devices, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
  - .2 Consider Architectural, Mechanical, and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Electrical Drawings.
  - .3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- .3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

## **1.11 SEQUENCING AND SCHEDULING**

- .1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to consultant. Should conditions arise where certain changes would be advisable, secure consultant's approval of these changes before proceeding with work.
- .2 Coordinate work of various trades in installing interrelated work. Before installation of electrical items, make proper provision to avoid interferences in a manner approved by consultant. Changes required in work specified in these sections caused by neglect to do so shall be made at no cost to owner.
- .3 Arrange fixtures, conduit, ducts, and equipment to permit ready access to junction boxes, starters, motors, control components, and to clear openings of doors and access panels.

- .4 Furnish and install inserts and supports required by these sections unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by the electrical trade.
- .5 Adjust locations of ducts, conduits, equipment, fixtures, etc., to accommodate work from interferences anticipated and encountered. Determine exact route and location of each conduit and duct prior to installation.
  - .1 Make offsets, transitions, and changes in direction of ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
  - .2 Supply and install pull boxes, etc., as required to affect these offsets, transitions, and changes in direction.

#### 1.12 REQUEST FOR INFORMATION (RFI) PROCEDURES

- .1 RFIs shall be submitted to the consultant a minimum of two (2) weeks prior to answer being required. Failure to submit and RFI in a timely manner will forfeit delay claims and schedule extension requests by the contractor.
- .2 All RFIs will be submitted with the following information:
  - .1 RFI number
  - .2 Name of project
  - .3 Date of initiation
  - .4 Date response required by (minimum two (2) weeks)
  - .5 Subject
  - .6 Submitter's name
  - .7 Drawing/specification reference
  - .8 Photograph of the issue (if applicable)
  - .9 Description of the issue
  - .10 Contractor's proposed resolution

#### 1.13 DRAW BREAKDOWN

- .1 This contractor **MUST** submit a breakdown of the tender price into classifications to the satisfaction of the consultant, with the aggregate of the breakdown totaling the total contract amount. **Each item must be broken out into material and labour costs.** Progress claims, when submitted are to be itemized against each item of the draw breakdown. This shall be done in table form showing contract amount, amount this draw, total to date, % complete and balance.
- .2 Breakdown shall be as follows:
  - .1 Permits and fees
  - .2 Mobilization (maximum 1%)
  - .3 Switchboard

- .4 Panelboards and miscellaneous distribution equipment
- .5 Generator System and associated transfer switches
- .6 Ductbank primary
- .7 Ductbank secondary
- .8 Secondary cables
- .9 Feeder conduits
- .10 Branch conduits
- .11 Feeder cables
- .12 Branch wiring
- .13 Lighting fixtures (interior)
- .14 Emergency lighting
- .15 Exterior lighting
- .16 Fire alarm system
- .17 Voice/Data system
- .18 Starters, contactors and control devices
- .19 Electric heating
- .20 Wiring for mechanical equipment
- .21 Wiring for owner's equipment
- .22 Cash allowances (itemized)
- .23 Integrated Life Safety System Testing**
- .24 Electrical contractor closeout requirements (minimum of 3% but not less than \$5,000.00)
- .3 The breakdown must be approved by the consultant prior to submission of the first draw.
- .4 Breakdowns not complying to the above will not be approved.
- .5 Breakdown must indicate total contract amount.
- .6 Mobilization amount may only be drawn when all required shop drawings have been reviewed by the consultant.**

#### **1.14 SHOP DRAWINGS AND PRODUCT DATA**

- .1 General
  - .1 Furnish complete catalog data for manufactured items of equipment to be used in the work to consultant for review within 14 days after award of Contract.
  - .2 Upon receipt of reviewed shop drawing, product is to be ordered immediately.
  - .3 Provide a complete list of shop drawings to be submitted prior to first submission.

- .4 Before submitting to the consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.
- .5 If material or equipment is not as specified or submittal is not complete, it will be rejected by consultant.
- .6 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.
- .7 **Submit all shop drawings for the project as a package. Partial submittals will not be accepted.**
- .8 Catalog data or shop drawings for equipment, which are noted as being reviewed by consultant or his engineer shall not supersede Contract Documents.
- .9 Review comments of consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- .10 Check work described by catalog data with Contract Documents for deviations and errors.
- .11 Shop drawings and product data shall show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances. e.g. access door swing spaces.
- .12 Shop drawings and product data shall be accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Manufacturer test data where requested.
  - .3 Manufacturer to certify as to current model production.
  - .4 Certification of compliance to applicable codes.
- .13 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.
- .14 **If a shop drawing is returned "reviewed as noted" this contractor must provide written indication that the comments have been complied with.**
- .15 A partial list of shop drawings includes:
  - .1 Switchboards, panelboards, and transformers (To be submitted AFTER the coordination study)
  - .2 Generator system, associated transfer switch(es), and enclosure
  - .3 Fire alarm system
  - .4 Luminaires and drivers



- .5 Emergency battery units, exit signs, and fixtures
  - .6 Electrical heaters
  - .7 Telecommunication system
  - .8 Starters, contactors and control devices
  - .9 Firestopping materials
  - .10 Hand dryers
  - .11 Wiring devices
  - .12 Cable management hangers
  - .13 Cable management system
  - .14 Lighting controls
  - .15 Digital time switch
  - .16 Disconnect switches and fuses
  - .17 Surge protection devices
  - .18 Grounding system components
  - .19 Destratification fans and associated controls
  - .20 Cable reels
  - .21 Miscellaneous enclosures
  - .22 Coordination study and arc flash hazard analysis
  - .23 Seismic restraint study
  - .24 Integrated Life Safety System Testing Plan (ITP)
- .2 Submissions shall be submitted electronically as per the following directions:
- .1 Electronic Submissions:
    - .1 Electronically submitted shop drawings shall be prepared as follows:
      - .1 Use latest software to generate PDF files of submission sheets.
      - .2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.
      - .3 PDF format shall be of sufficient resolution to clearly show the finest detail.
      - .4 PDF page size shall be standardized for printing to letter size (8.5" x 11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11" x 17".
      - .5 Submissions shall contain multiple files according to section names as they appear in Specification.
      - .6 File names shall include consultant project number and description of shop drawing section submitted.
      - .7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.

- .8 On the shop drawing use an “electronic mark” to indicate what is being provided.
- .9 **Each file shall bear an electronic representation of the “company stamp” of the contractor. If not stamped the file submission will not be reviewed.**
- .2 Email submissions shall include subject line to clearly identify the consultants’ project number and the description of the shop drawings submitted.
- .3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating “1 of 2” and “2 of 2” in email subject line for the case of two messages.
- .4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.
- .5 On site provide one copy of the “reviewed” shop drawings in a binder as noted above.
- .6 Contractor to print copies of “reviewed” shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

#### **1.15 CARE, OPERATION AND START-UP**

- .1 Instruct consultant and operating personnel in the operation, care and maintenance of equipment.
- .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 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.

#### **1.16 VOLTAGE RATINGS**

- .1 Operating voltages: to CAN3-C235-83.
- .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.

#### **1.17 PERMITS, FEES AND INSPECTION**

- .1 A submission has been made (if required by this scope of project) by the consultant to the Electrical Safety Authority for review of this project. The payment of the required review costs will be coordinated by the consultant. A copy of the Electrical Safety Authority review report will be forwarded to the successful contractor for information and action.

- .2 The contractor is required to include in his tender all required inspection costs by the Electrical Safety Authority. Permit application is the responsibility of the contractor.
- .3 Reproduce drawings and specifications required by Electrical Safety Authority at no cost.
- .4 Notify consultant of changes required by Electrical Safety Authority prior to making changes.
- .5 Furnish Certificates of Acceptance to consultant from Electrical Safety Authority and other authorities having jurisdiction upon completion of work.
- .6 This contractor must furnish any certificates required to indicate that the work completed conforms with laws and regulations of authorities having jurisdiction.

**1.18 ADDITIONAL INSTALLED EQUIPMENT**

- .1 The electrical contractor is to review all specification sections forming part of the electrical bid documents and include additional equipment or components, as well as all associated installation costs and testing costs as noted, in the electrical bid price.

**1.19 MATERIALS AND EQUIPMENT**

- .1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority.
- .2 Factory assemble control panels and component assemblies.

**1.20 ELECTRIC MOTORS, EQUIPMENT, AND CONTROLS**

- .1 Supplier and installer responsibility is indicated in the Equipment Wiring Schedule on electrical drawings.
- .2 Control wiring and conduit is specified in the Electrical specifications except for conduit, wiring and connections below 50 V, which are related to control systems specified in the Mechanical specifications.

**1.21 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint indoor switchgear and distribution enclosures light grey.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks, fastenings, and conduits etc. to prevent rusting.

## 1.22 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
- .2 Nameplates:
  - .1 Lamicoid 3 mm (1/8") thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

### NAMEPLATE SIZES

Size 1	9 mm x 50 mm (3/8" x 2")	1 line	3 mm (1/8") high letters
Size 2	12 mm x 70 mm (1/2" x 2 1/2")	1 line	5 mm (3/16") high letters
Size 3	12 mm x 70 mm (1/2" x 2 1/2")	2 lines	3 mm (1/8") high letters
Size 4	20 mm x 90 mm (3/4" x 3 1/2")	1 line	9 mm (3/8") high letters
Size 5	20 mm x 90 mm (3/4" x 3 1/2")	2 lines	5 mm (3/16") high letters
Size 6	25 mm x 100 mm (1" x 4")	1 line	12 mm (1/2") high letters
Size 7	25 mm x 100 mm (1" x 4")	2 lines	6 mm (1/4") high letters

- .3 Wording on nameplates labels to be approved by consultant prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Nameplates for disconnects, starters and contactors must indicate equipment being controlled and voltage.
- .8 Nameplates for transformers must indicate transformer label as indicated and capacity, primary, and secondary voltages.
- .9 Nameplates for equipment connected to emergency services are to be red in colour.

## 1.23 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

## 1.24 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m (45') intervals.

- .3 Colour bands must be 25 mm (1") wide.

	<u>Prime</u>
up to 208 V	yellow
209 to 600 V	white
Voice system	green
Data System	orange
Security	brown
Fire alarm	red
Emergency lighting	pink
Emergency up to 208V	yellow/red/yellow (striped)
Emergency 209 to 600V	white/red/white (striped)

- .4 This contractor must paint all system junction boxes and covers in conformance with the above schedule.

#### **1.25 PROTECTION OF OPENINGS**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

#### **1.26 WIRING TERMINATIONS**

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

#### **1.27 MANUFACTURERS AND CSA LABELS**

- .1 All labels must be visible and legible after equipment is installed.

#### **1.28 WARNING SIGNS**

- .1 To meet requirements of Electrical Safety Authority and consultant.  
.2 Provide porcelain enamel signs, with a minimum size of 175 mm x 250 mm (7" x 10").

#### **1.29 LOCATION OF OUTLETS**

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm (6") horizontal clearance between boxes.  
.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3 m (10'), and information is given before installation.  
.3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

#### **1.30 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).  
.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

- .1 Local switches: 1100 mm (43.3").
- .2 Wall receptacles:
  - .1 General: 400 mm (16").
  - .2 Above top of counters or counter splash backs: 100 mm (4").
  - .3 In mechanical rooms: 1200 mm (48").
- .3 Panelboards: as required by Code or 1400 mm (56").
- .4 Voice/Data outlets: At height of adjacent outlet or at 400 mm (16").
- .5 Fire alarm stations: 1200 mm (3'-11").
- .6 Fire alarm visual and signal devices: 2250 mm (88 ½").
- .7 Television outlets: Confirm with Architectural elevations
- .8 Thermostat: 1200 mm (3'-11").
- .9 Heaters: 200 mm (8" AFF) to bottom of heater.
- .10 Emergency call switches and/or pushbuttons: 900 mm (36").

#### **1.31 LOAD BALANCE**

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

#### **1.32 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm (2") beyond either side.
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

#### **1.33 FIELD QUALITY CONTROL**

- .1 Conduct and pay for following tests:
  - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.

- .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .5 Systems: fire alarm system, communications, security.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing.
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.
- .4 Carry out tests in presence of consultant.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for consultant's review.

**1.34 EQUIPMENT NAMEPLATE DATA**

- .1 Refer to the Equipment Wiring Schedule, Distribution Diagram(s) and Panel Schedules for information regarding the designed electrical connections for all equipment to be connected to the electrical distribution system.
- .2 Refer to the shop drawing submissions of all project divisions and coordinate with all trades and equipment manufacturers throughout the construction period for equipment connection requirements.
- .3 This electrical trade shall be responsible to coordinate any discrepancies on equipment minimum circuit ampacity, maximum overcurrent protection, voltage and phase, between the equipment manufacturer published literature, the equipment shop drawing submission, the project design drawings equipment wiring schedule, and the nameplate data on the equipment. The contractors installing and connecting all equipment shall be responsible for the coordination of this data through the construction period.
- .4 Equipment shall not be connected where the specified maximum overcurrent protection and minimum circuit ampacity values do not meet the requirements of the equipment nameplate data on site.
- .5 Electrical distribution equipment shop drawings shall not be submitted prior to approval of equipment to be connected including, but not limited to, mechanical units, pumps, elevators, etc. Electrical distribution equipment shall not be released into production until all connected equipment requirements are confirmed and included in approved shop drawings.
- .6 Where nameplate data of equipment on site varies from that data listed in the approved equipment shop drawings, the consultant shall be notified in writing, and the equipment shall not be connected until the equipment connection details are confirmed. The final installation must meet the nameplate data of the equipment on site.

- .7 No subsequent allowance for time or money for changes to breakers, wiring and conduit, or equipment sizes will be considered for any consequence related to failure by the electrical trade to coordinate final equipment connection requirements with nameplate data and electrical distribution equipment shop drawings.

#### **1.35 COORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated on drawings or as determined from coordination study.
- .2 Electrical connections to all equipment requiring connection to the electrical distribution system as part of this electrical tender have been specified according to the anticipated equipment manufacturer electrical requirements and the applicable sections of the OESC. This contractor must coordinate electrical connections to all equipment specified to be connected as part of this electrical tender.
- .3 Prior to submitting electrical distribution shop drawings to the consultant, review all shop drawings for all equipment specified for connection to the electrical distribution system to verify that the product electrical connection requirements listed by the manufacturer conform to the equipment electrical connections specified on the electrical design drawings and specifications. Make necessary revisions to breaker ratings associated with the review of all product shop drawings and identify such changes as part of the electrical distribution equipment shop drawing submission.
- .4 Prior to making final equipment connections, this electrical contractor shall examine equipment nameplates at the project site to confirm voltage and phase requirements, minimum circuit ampacity and maximum overcurrent protection values, and bring to the attention of the consultant in writing any connection requirements which may vary from the designed connections or approved electrical distribution shop drawings. No subsequent allowance for time or money for changes to breaker or wire and conduit sizes will be considered for any consequence related to failure to examine site conditions.

#### **1.36 GUARANTEE AND WARRANTY**

- .1 At ready for takeover of this project this Contractor must provide a written guarantee indicating that any defects, not due to ordinary wear and tear or improper use which occur within the first year from the date of ready for takeover will be corrected at the contractor's expense.
- .2 Warranty period shall start from date of ready for takeover completion.
- .3 Refer to individual specification sections for information on any special manufacturer's equipment warranties.

#### **1.37 SYSTEM START UP**

- .1 Provide consultant with written notice verifying all equipment operation and installation is complete prior to scheduled start-up period.



- .2 Start up shall be in presence of the following: owner or representative, contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.
- .3 Arrange with all parties and provide 72 hours notice for start up procedure.
- .4 Simulate system start up and shut down and verify operation of each piece of equipment.
- .5 These tests are to demonstrate that the systems and equipment installed are operational as specified.
- .6 The contractor must describe during the start up session the required maintenance for each piece of equipment according to the manufacturer.
- .7 The contractor must provide all necessary tools (including a digital multimeter) to successfully complete the start up procedure.

### **1.38 OPERATION AND MAINTENANCE MANUAL**

- .1 Provide operation and maintenance data for incorporation into manual as specified in other Sections of this Division.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, consultant before final inspection.
  - .1 Submit 1 copy of Operation and Maintenance Manual to consultant for approval. Submission of individual data will not be accepted unless so directed by consultant. Submission can be done electronically in pdf format or as a hardcopy.
    - .1 Electronic submission/pdf file is required to be bookmarked. Any submission received without bookmarking will be immediately returned as unacceptable.
    - .2 Hardcopy submission shall be in a three-ring binder (minimum 50 mm (2") ring) and labelled as 'Operation and Maintenance Manual' with project name and location. Dividers are to be used for binder organization.
  - .2 Make changes as required and re-submit as directed by consultant.
- .3 Each manual must include (in "tabbed" sections) the following:
  - .1 Index
  - .2 List of General, Mechanical, Electrical Contractors and all associated sub-contractor names, addresses and contact numbers.
  - .3 List of suppliers and equipment wholesalers local to the project.
  - .4 Letter of contractor's warranty and guarantee for all parts, equipment and workmanship.
  - .5 List of manufacturers, spare parts list and source.
  - .6 Copy of typewritten schedules for all new panels.
  - .7 Copy of all substantial performance final certificates.

- .8 Copy of electrical shop drawings which have been stamped and reviewed by consultant.
- .9 Electrical As-built drawings including contractor company's as built stamp.
- .10 Coordination study/Arc flash hazard study shop drawings
- .11 Certificate of completion from all associated sub-contractors.
- .12 Cable test results and floor plans containing address labels.
- .13 Any special warranties on equipment required (i.e. LED lighting, digital lighting control, SPDs, power generation).
- .14 System commissioning certificate and report.
- .4 Final Submittals:
  - .1 Upon acceptance of Operation and Maintenance Manual by the consultant provide the following:
    - .1 Provide one (1) for copy of final operation maintenance manual, as well as a PDF file of the entire approved manual on a USB stick. Only one USB stick is to be provided containing both the approved manual and as-built drawings.

#### **1.39 AS-BUILT DRAWINGS**

- .1 Site records:
  - .1 Contractor shall provide 2 sets of reproducible electrical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include field and contract changes to electrical systems.
  - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
  - .1 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
  - .2 Submit hard copy to consultant for approval. When returned, make corrections (if any) as directed.
  - .3 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy on USB stick with Operating and Maintenance Manuals.

#### **1.40 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS**

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Manufacturers or their representatives are to provide demonstrations and instructions.

- .3 Use operation and maintenance manual, As-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, consultants may record these demonstrations on video tape for future reference.

#### **1.41 OCCUPANCY REQUIREMENTS**

- .1 The contractor shall provide the following documentation to the consultant's satisfaction prior to receiving occupancy. Failure to provide the proper documentation will result in the occupancy not being granted. List of required documentation:
  - .1 Final Certificates (required prior to consultant's release of conformance letter).
    - .1 Electrical Safety Authority.
    - .2 Emergency Lighting.
    - .3 Testing of Integrated Fire Protection and Life Safety Systems Report.
    - .4 Generator Testing Certificate.
    - .5 Electrical Seismic Restraint Engineers' Letter.
    - .6 Fire Alarm Verification Certificate.

#### **1.42 READY FOR TAKEOVER**

- .1 Complete the following to the satisfaction of the consultant prior to request for ready for takeover.
  - .1 As-built Drawings.
  - .2 Maintenance Manuals.
  - .3 System Start up.
  - .4 Instructions to Owners.
  - .5 Coordination Study / Arc Flash Hazard (including photos of each breaker).
  - .6 Lighting Control System.
  - .7 Auxiliary Systems (SPDs, etc.).
  - .8 **Outlet cover circuit labels.**

#### **1.43 TRIAL USAGE**

- .1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

#### **1.44 REVISION TO CONTRACT**

- .1 Provide the following for each item in a given change notice in addition to the procedures in general conditions of CCDC2:
  - .1 Itemized list of material with associated costs.
  - .2 Labour rate and itemized list of labour for each item.
  - .3 Copy of manufacturers/suppliers invoice if requested.

**1.45 EQUIPMENT SUPPORTS**

- .1 Equipment supports supplied by equipment manufacturer: shall be installed by the electrical contractor.
- .2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings if necessary.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. This installation of this pad shall be the responsibility of the electrical contractor.
- .4 This contractor shall be responsible for providing all anchor bolts and associated formed concrete bases for lighting standards as detailed.

**1.46 SLEEVES**

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete, or fire rated assemblies and as indicated.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
  - .1 Through foundation walls.
  - .2 Where sleeve extends above finished floor.
- .4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and conduit.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.
- .6 Through foundation walls PVC sleeves are acceptable.
- .7 Fill voids around pipes:
  - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
  - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
  - .3 Fill future-use sleeves with easily removable filler.

**1.47 FIRESTOPPING**

- .1 Firestopping material and installation within annular space between conduits, ducts, and adjacent fire separation.
- .2 Provide materials and systems capable of maintaining effective barrier against flame, smoke, and gases.
- .3 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- .4 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation.

- .5 The firestopping materials are not to shrink, slump or sag and be free of asbestos, halogens and volatile solvents.
- .6 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .7 Firestop materials are to be capable of receiving finish materials in those areas, which are exposed and scheduled to receive finishes.
- .8 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.
- .9 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.
- .10 Submit product literature and installation material on firestopping in shop drawing and product data manual.**
- .11 Acceptable manufacturers:
  - .1 Rectorseal Corporation (Metacaulk)
  - .2 Proset Systems
  - .3 3M
  - .4 Hilti
  - .5 STI Firestop
- Note: Fire stop material must conform to requirements of local authorities having jurisdiction. Contractor to confirm prior to application and ensure material used is compatible with that used by other trades on site.**
- .12 Ensure firestop manufacturer representative performs on site inspections and certifies installation. Submit inspection reports/certification at time of ready for takeover.

#### **1.48 PAINTING**

- .1 Refer to Section Interior Painting and specified elsewhere.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Prime and touch up marred finished paintwork to match original.
- .4 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

#### **1.49 ACCESS DOORS**

- .1 Supply access doors to concealed electrical equipment for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600 mm x 600 mm (24" x 24") for body entry and 300 mm x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

- .3 Material:
  - .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by consultant.
  - .2 Remaining areas: use prime coated steel.
  - .3 Fire rated areas: provide ULC listed access doors
- .4 Installation:
  - .1 Locate so that concealed items are accessible.
  - .2 Locate so that hand or body entry (as applicable) is achieved.
  - .3 Installation is specified in applicable sections.
- .5 Acceptable materials:
  - .1 Le Hage
  - .2 Zurn
  - .3 Acudor
  - .4 Nailor Industries Inc.

**1.50 DELIVERY STORAGE & HANDLING**

- .1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials. Contractor to include all costs associated with delivery storage and handling in tender price.
- .2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury, but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.

**1.51 REPAIR, CUTTING, CORING AND RESTORATION**

- .1 Be responsible for required digging, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.
- .2 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- .3 Slots, cores and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

**1.52 CLEANING**

- .1 Clean interior and exterior of all electrical equipment provided including light fixture lenses.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

**1.53 OWNER SUPPLIED EQUIPMENT**

- .1 Connect to equipment supplied by the owner and make operable.
- .2 Design drawings are diagrammatic and do not necessarily indicate all specific final connection requirements. For the purposes of bidding, electrical trade shall include but not be limited to provision of a junction box to connect equipment wiring tail, provision of suitable disconnecting means, and flexible connection directly to equipment.

**1.54 ENCLOSURES**

- .1 This contractor must ensure that all electrical equipment mounted in sprinklered areas is provided with an enclosure in conformance with the Electrical Safety Code.

**1.55 ELECTRICAL SYSTEMS COMMISSIONING**

- .1 Refer to specification section 26 01 19 Commissioning of Electrical Systems for information on required electrical contractor participation and typical commissioning agent duties

**1.56 INTEGRATED LIFE SAFETY SYSTEM TESTING**

- .1 The Integrated Life Safety System Testing Coordinator (ITC) shall be hired by the electrical trade as indicated in specification section 26 01 20.
- .2 This electrical contractor shall work with the project Integrated Life Safety System Testing Coordinator (ITC) and participate in all phases of the Integrated Life Safety Systems testing process as specified within CAN/ULC S1001-11 (2024 Rev2 updates) as well as the electrical and architectural specifications.
- .3 During the **Planning Phase** of the Integrated Life Safety Systems Testing process this electrical contractor shall review the Integrated Testing Plan (ITP) and give written confirmation of this review and acknowledgement of affected systems under his responsibility as required by the electrical specifications per the shop drawing submittal process.
- .4 Prior to the building Integrated Life Safety Systems Testing this electrical contractor shall startup/commission/verify the operation of all systems under the responsibility of this electrical trade. This electrical trade shall give written indication of completed systems and provide copies of all inspection reports, start-up reports, commissioning reports, verification reports, etc. when requested by the ITC during the **Implementation Phase**.
- .5 Upon completion of the building Integrated Life Safety Systems Testing this electrical contractor shall rectify all deficiencies related to all systems under his responsibility during the **Testing Phase** in due time for the ITC to verify and document for the project team.

**END OF SECTION**

**Part 1 General**

**1.1 WORK INCLUDED**

- .1 Section 21 02 51 – FIRE PROTECTION GENERAL REQUIREMENTS and DIVISION 1
- .2 Section 21 13 13 – WET PIPE FIRE SUPPRESSION
- .3 Section 23 02 52 – HVAC GENERAL REQUIREMENTS and DIVISION 1
- .4 Section 23 33 17 – SMOKE CONTROL DAMPERS
- .5 Section 26 01 16 – ELECTRICAL GENERAL REQUIREMENTS and DIVISION 1
- .6 Section 26 32 16 – POWER GENERATION NATURAL GAS
- .7 Section 26 36 23 – AUTOMATIC TRANSFER SWITCH (ATS)
- .8 Section 26 51 13 – LIGHTING EQUIPMENT
- .9 Section 26 51 16 – DIGITAL OCCUPANCY & DAYLIGHT CONTROL SYSTEMS
- .10 Section 28 31 25 – FIRE ALARM SYSTEM (ADDRESSABLE)
- .11 Applicable building systems in item 1.3.10 and as included in all project DIVISIONS.

**1.2 REFERENCES**

- .1 OBC-2024, Ontario Building Code Compendium.
- .2 CAN/ULC-1001, Integrated System Testing of Fire Protection and Life Safety Systems.
- .3 CAN/ULC-S524, Installation of Fire Alarm Systems.
- .4 CAN/ULC-S537, Verification of Fire Alarm Systems.
- .5 CAN/ULC-S573, Installation of Ancillary Devices Connected to Fire Alarm Systems
- .6 CAN/ULC-S561, Installation and Service for Fire Signal Receiving Centres and Systems
- .7 CAN/ULC-S112, Standard Method of Fire Test of Fire Damper Assemblies
- .8 NFPA 13, Fire Sprinkler Systems
- .9 NFPA 17A, Standard for Wet Chemical Extinguishing Systems
- .10 NFPA 92, Standard for Smoke Control Systems
- .11 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

**1.3 OVERVIEW**

- .1 All work shall be performed in accordance with CAN/ULC-1001 Integrated System Testing of Life Safety and Fire Protection Systems, latest edition.
- .2 The Building Code has adopted CAN/ULC-1001 as the standard to comply with Integrated System Testing of Life Safety and Fire Protection Systems. The scope of this project shall follow the strict guidelines laid out in CAN/ULC-1001 for Integrated Testing Planning, review, and implementation.



- .3 The Integrated Testing Plan (ITP) will provide a full overview of all integration points of life safety and fire protection systems. The ITP will be submitted for review to the design professionals and Authority Having Jurisdiction (AHJ). Upon the successful completion of the ITP and all the respective systems, the Integrated Testing Coordinator (ITC) will provide a schedule to the design professionals, the AHJ, and all required participating members for the ITP to be conducted.
- .4 The ITC will review all drawings, specifications, sequence of operations, and methodology prepared by the design professionals, complete with the contractor's shop drawings and manufacture requirements.
- .5 The ITP shall be coordinated with all sub-contractors and suppliers as outlined in item 1.1.
- .6 The ITC will conduct the ITP and will sign each integrated test form, complete with signatures from each participating member of the integrated systems.
- .7 The ITC shall witness all integrations and not rely on the CAN/ULC-S537 Verification Inspection Report for fire protection system integration testing; however, the ITC may attend the verification to validate the testing.
- .8 The ITC will provide all work and ITP including functional documentation, prescribed in CAN/ULC-1001. Such testing and documentation have been deemed to satisfy OBC 2024 Sentence 3.2.9.
- .9 The ITC will provide PDF and digital media copy of the buildings ITP and Integrated System Report (ITR) for the building owner's use, re-testing, and reproduction purpose.
- .10 The systems applicable to the function testing include but not limited to:
  - .1 Fire Alarm System (including sequence of operations) and Monitoring
  - .2 Sprinkler Systems
  - .3 Life Safety Generator and Automatic Transfer Switches
  - .4 Kitchen Fire Suppression Systems
  - .5 Fixed Fire Suppression Systems
  - .6 Smoke Damper Assemblies
  - .7 Emergency Lighting
  - .8 CO System
  - .9 HVLS Fan Shutdown

## **Part 2 Products**

### **2.1 TESTING AND PLANNING**

- .1 The Integrated Testing Process must include following:
  - .1 Planning phase by the testing coordinator.
  - .2 Integrated testing plan review by the design professionals.
  - .3 Integrated testing plan review by the AHJ.
  - .4 Review of sequence of operations.

- .5 System documentation.
- .6 Integrated System Testing Plan consisting of:
  - .1 Project description.
  - .2 Project contacts including applicable project responsibilities.
  - .3 Overview and description of each integrated system.
  - .4 System integrations and functional objective of each integrated system.
  - .5 Integration matrix of all integrated system complete with integration type, normal mode and off-normal mode.
  - .6 Test protocols and procedures of each integrated system,
  - .7 Notifications.
  - .8 Personnel safety.
  - .9 Phased occupancies.
  - .10 Pre-testing documentation checklist.
  - .11 Pre-testing documentation acknowledgement forms.
  - .12 Testing forms.
  - .13 Ongoing integrated system testing forms.
  - .14 Integrated system testing completion form.
  - .15 Integrated testing notes.

## **2.2 RESPONSIBILITIES**

- .1 General Contractor:
  - .1 Coordinate with the ITC for schedule and witness testing.
  - .2 Coordinate all responsible sub-contractors.
  - .3 Confirm all respective systems listed in item 1.3.10 are complete and fully operational, prior to the ITC commencing the functional testing.
  - .4 Provide reports for respective systems such as, but not limited to; TSSA elevator inspection reports, start-up reports, commissioning reports, verification reports.
  - .5 Participate in the ITP and provide function testing of equipment within the mechanical, electrical, and fire protection contract packages.
  - .6 Allow for any cost associated to re-testing of the ITP due to failures or insufficient work.
  - .7 Allow for any cost associated with phased occupancy and phased Integrated Testing work.
- .2 HVAC Contractor:
  - .1 The HVAC Contractor shall confirm all mechanical systems listed in item 1.3.10 are complete and fully operational, prior to the ITC commencing the functional testing.

- .2 Provide system reports such as, but not limited to; air balancing reports, TSSA inspection reports, start-up reports, commissioning reports, verification reports. The Mechanical Contractor shall further provide written confirmation that all mechanical systems are installed and operating as intended by the contract documents and sequence of operations.
- .3 Participate in the ITP and provide function testing of equipment within the mechanical contract package.
- .4 Allow for any cost associated to re-testing of the ITP due to failures or insufficient work.
- .5 Allow for any cost associated with phased occupancy and phased Integrated Testing work.
- .3 Fire Protection Contractor:
  - .1 The Fire Protection Contractor shall confirm all fire protection systems listed in item 1.3.10 are complete and fully operational, prior to the ITC commencing the functional testing.
  - .2 Provide system reports such as, but not limited to; NFPA 13 letter, NFPA 20, letter, above ground sprinkler piping letter, below ground sprinkler letter, system designer letter, start-up reports, commissioning reports, verification reports. The Fire Protection Contractor shall further provide written confirmation that all fire protection systems are installed and operating as intended by the contract documents and sequence of operations.
  - .3 Participate in the ITP and provide function testing of equipment within the fire protection contract package.
  - .4 Allow for any cost associated to re-testing of the ITP due to failures or insufficient work.
  - .5 Allow for any cost associated with phased occupancy and phased Integrated Testing work.
- .4 Electrical Contractor:
  - .1 Electrical Contractor to employ the services of the ITC firm as a sub-contractor and include in bid price. Refer to item 2.6.
  - .2 The electrical contractor shall confirm all electrical systems listed in item 1.3.10 are complete and fully operational, prior to the ITC commencing the functional testing.
  - .3 Provide system reports such as, but not limited to; ESA Inspection Certificate, Fire Alarm Verification, TSSA Inspection, Generator Start-up report, commissioning reports, and verification reports. The Electrical Contractor shall further provide written confirmation that all electrical systems are installed and operating as intended by the contract documents and sequence of operations.
  - .4 Participate in the ITP and provide function testing of equipment within the electrical contract package.
  - .5 Allow for any cost associated to re-testing of the ITP due to failures or insufficient work.
  - .6 Allow for any cost associated with phased occupancy and phased Integrated Testing work.

- .5 Equipment Manufacturers:
  - .1 Where required, shall confirm all respective systems listed in item 1.3.10 are complete and fully operational, prior to the ITC commencing the functional testing.
  - .2 Participate in the ITP and provide function testing of equipment within the respective contract package.
- .6 Design Professionals:
  - .1 The design professional shall include, but not be limited to, the project Architect, Electrical and Mechanical Consultants, Fire Protection Engineer, Elevator Consultant, etc.
  - .2 Shall review the ITP, and upon review, accept the ITP as the agreed ITP for implementation.
  - .3 The design professionals are responsible for design. Upon an unsuccessful test, the failure will be documented and provided to the respective design professionals for review and action.

## 2.3 NOTIFICATION OF TESTING PLANNING PROCESS

- .1 The ITC shall work with the General Contractor, Owner, sub-contractors, design professionals, and the AHJ to provide a schedule for the implementation of the ITP.
- .2 The ITC shall obtain contact names, contact details, and system responsibilities for all project design professionals.
- .3 The ITC shall provide notification to the integrated testing participants seven (7) days prior to the date and time for the implementing of the ITP.
- .4 Prior to testing, the ITC shall obtain written acknowledgement for acceptance and understanding of the ITP by all project design professionals and contractors per 1001 Section 5 and Appendix B. Include ITP Review & Acceptance acknowledgement sheet in the ITR. **Refer to Figure 1.**
- .5 Prior to testing, the ITC shall obtain written acknowledgement for acceptance testing of site readiness from all project design professionals and contractors per 1001 Section 5 and Appendix B. Failure to obtain acknowledgement prior to implementation of integrated testing may invalidate the results and could result in delays by the design professionals issuing conformance. Include ITP Acceptance Testing acknowledgement sheet in the ITR. **Refer to Figure 2 and Figure 3.**
- .6 In the event of building occupants, the ITC shall provide at a minimum, forty-eight (48) hour notice of the implementation of the integrated testing. Notification shall be provided via written notices posted at each building entrance.
- .7 Partial occupancies shall employ this process for each individual occupancy and shall clearly identify the extent of to which the partial occupancy applies when obtaining written confirmations.

- .8 Figures 1 through 3 of this specification section are indicated as informative and are for information only regarding the intent for required written acknowledgement gathering by the ITC. All designers and trades listed may not apply to all projects. The ITC shall be responsible for determining all required designers and contractors for the project based on the contact information from the ITP.

## **2.4 TESTING IMPLEMENTATION PROCESS**

- .1 Implementation of the integrated test shall follow all job site and personnel safety requirements set out in the contract and General Contractors requirements.
- .2 The ITC shall define:
  - .1 Personnel safety protocols
  - .2 Special hazards
  - .3 Team communications
  - .4 Occupant notification of emergencies
- .3 The integrated system test shall follow the methodology and process outlined in CAN/ULC-1001 as the requirement for this project.
  - .1 Provide the final ITP to the Consultant fourteen (14) days prior to scheduled implementation and test.
- .4 The respective contractors and manufactures are responsible to start-up and function test their respective systems, for observation and witnessing by the ITC. The ITC will record the results, and the respective contractor and manufacture will restore the system to a normal condition. Upon successful testing the contractor and manufacture will initial the respective integrated testing from adjacent to their respective test.
- .5 Upon a failure of a test, the ITC will document the failure and continue with the testing of other integrations. The respective contractor and manufacture will document the failure, notify they design professional, and correct the failure under the direction of the design professional.
  - .1 The ITC will re-test the unsuccessful integration after the correction has been documented and verified.
- .6 Upon a failure of a device (such as a smoke detector), the contractor may immediately replace the device, and the ITC may continue to test the integration. The device failure maybe documented but shall not result in a failed integrated test.
- .7 The ITC shall include in quote costs associated with site testing of all integrated devices. ITPs and testing procedures which include only for a sampling of devices will not be accepted. ITPs and testing procedures which rely solely on inspection reports, start-up reports, commissioning reports, or verification reports, etc. will not be accepted.
- .8 Partial occupancies shall employ this process for each individual occupancy and shall clearly identify the extent to which the partial occupancy applies when obtaining written confirmations.
- .9 Upon successfully completing the ITP, the ITC shall provide the ITR to the design professionals and building owner.

## **2.5 QUALITY CONTROL**

- .1 The ITC must meet the following criteria to be considered acceptable for this project:
  - .1 Firms regular engaged with contractors in function testing, fire alarm verification, sprinkler system testing, annual inspections and maintenance of fire and life safety systems.
  - .2 Firms knowledgeable and experience of the respective Codes and Standards of the particular project, including but not limited to; Building Codes, Fire Codes, ULC Standards, CSA Standards, and NFPA Standards.
  - .3 Firms must be a member in good standing of the Canadian Fire Alarm Association (CFAA).
  - .4 Vendors must be a 3<sup>rd</sup> party and independent from the fire protection and life safety system installation company present on the project in accordance with ULC Certification Bulletin 2020-08.
  - .5 Firms must maintain operations in the province of Ontario for at least five years.
  - .6 The coordinator shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the systems.

## **2.6 QUALIFIED INTEGRATED TESTING COORDINATOR**

- .1 Bidders may choose from the experienced ITC Firms listed below or local branches of these companies noted in the vicinity of this project and are acceptable as a sub-contractor to the Electrical Contractor:
  - .1 Lonergan Engineering  
3A-235 Industrial Parkway South  
Aurora, Ontario L4G 3V5
  - .2 ITC Solutions  
20 Hanson Ave Unit 3  
Kitchener, ON, N2C 2E2
  - .3 Troy Life & Fire Safety  
805 Boxwood Dr., Unit #201  
Cambridge, Ontario N3E 1A4

**END OF SECTION**

**Figure 1 – Example Pre-Test ITP Acknowledgement (Typical Design Professionals): Informative**

INTEGRATED SYSTEMS WRITTEN ACKNOWLEDGEMENT REVIEW AND ACCEPTANCE OF INTEGRATED TEST PLAN (EXAMPLE)			
Per Item 5.2.8 and Section B9.1 of CAN/ULC S1001 (latest version), the respective design professionals shall indicate written confirmation to the Testing Coordinator acceptance of the Integrated systems Test Plan according to the intent of the project design documents.			
List of Design Professionals		Company/Representative	Design Responsibility
Architect	Company Name:		
	Designer Name:		
	Signature		
Electrical Engineer	Company Name:		
	Designer Name:		
	Signature		
Mechanical Engineer	Company Name:		
	Designer Name:		
	Signature		
Fire Protection Engineer (sprinkler)	Company Name:		
	Designer Name:		
	Signature		
(typical responsible consultant on project)	Company Name:		
	Designer Name:		
	Signature		

**Figure 2 – Example Pre-Test Trade Site Ready Acknowledgement (Typical Project Trades): Informative**

PRE-TESTING INTEGRATED SYSTEMS WRITTEN ACKNOWLEDGEMENT (EXAMPLE)			
Per Item 5.3.1.(B) and Section B8.1 of CAN/ULC S1001 (latest version), the respective installing contractors shall indicate written confirmation to the Testing Coordinator that their respective life safety systems have been installed in accordance with the design are ready for integrated testing as outlined within the Integrated Systems Testing Plan.			
List of Installing Trades		Company/Representative	System Responsibilities
General Contractor	Company Name:		
	Name:		
	Signature		
Electrical Contractor	Company Name:		
	Name:		
	Signature		
Mechanical Contractor	Company Name:		
	Name:		
	Signature		
Sprinkler Contractor	Company Name:		
	Name:		
	Signature		
Elevator Contractor	Company Name:		
	Name:		
	Signature		
(typical responsible trade on project)	Company Name:		
	Name:		
	Signature		

**Figure 3 – Example Pre-Test Designer Site Ready Acknowledgement (Typical Design Professionals):**  
 Informative

PRE-TESTING INTEGRATED SYSTEMS WRITTEN ACKNOWLEDGEMENT (EXAMPLE)			
Per Item 5.3.1 (A) and Section B8.1 of CAN/ULC S1001 (latest version), the respective design professionals shall indicate written confirmation to the Testing Coordinator that the site is ready for integrated systems testing per the descriptions and integrations outlined within the Integrated Systems Testing Plan.			
List of Design Professionals		Company/Representative	Design Responsibility
Architect	Company Name:		
	Designer Name:		
	Signature		
Electrical Engineer	Company Name:		
	Designer Name:		
	Signature		
Mechanical Engineer	Company Name:		
	Designer Name:		
	Signature		
Fire Protection Engineer (sprinkler)	Company Name:		
	Designer Name:		
	Signature		
(typical responsible consultant on project)	Company Name:		
	Designer Name:		
	Signature		



**Part 1 General**

**1.1 REFERENCES**

- .1 CSA C22.2 No.0.3-92, Test Methods for Electrical Wires and Cables.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Electrical General Requirements Section.

**Part 2 Products**

**2.1 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger.
- .2 Minimum size: 12 AWG.
- .3 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material 90°C (194°F) rated T90 for indoor above grade installations and RW90 for below grade installations.

**2.2 ARMoured CABLES**

- .1 Conductors: insulated, copper minimum size as indicated above.
- .2 Type: AC90 (minimum size 12 AWG).
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors must be suitable for installed environment and approved for use with armoured cable.

**Part 3 Execution**

**3.1 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring from source to load through raceways as specified.
- .2 Provide separate neutral conductors for all lighting circuits and circuits originating from surge protected panels. Size raceways accordingly.

**3.2 INSTALLATION OF ARMoured CABLES**

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Wire and Box Connectors - 0 - 1000 V Section.

- .3 These cables are to be installed in concealed locations only. These concealed locations are considered to be stud walls and “drops” to stud walls, lighting fixtures, and ceiling mounted devices.
- .4 **These “drops” shall not be permitted to exceed 2.4 m (8'-0"). To limit these “drops” to lengths noted above provide additional branch wiring in conduit.**

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data for cabinets in accordance with Electrical General Requirements Section.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Splitters must conform to CSA C22.2 No. 76 (latest edition).
- .2 Junction and pull boxes must conform to CSA C22.2 No. 40 (latest edition)

**2.2 JUNCTION AND PULL BOXES**

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

**Part 3 Execution**

**3.1 JUNCTION AND PULL BOXES INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install junction and pull boxes so as not to exceed 30 m (100') of conduit run between pull boxes and in conformance with the Electrical Safety Code.

**3.2 IDENTIFICATION**

- .1 Provide equipment identification in accordance with General Electrical Requirements Section.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Outlet boxes, conduit boxes, and fittings must conform to CSA C22.2 No. 18 (latest edition).

**Part 2 Products**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm (4") square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

**2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 64 mm (3" x 2" x 2½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required. Iberville 1104 Series.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit **in utility rooms**, minimum size 102 mm x 57 mm x 38 mm (4" x 2¼" x 1½"). Iberville 1110 Series.
- .3 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.
- .4 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished tile walls.

**2.3 MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

**2.4 CONCRETE BOXES**

- .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**

- .1 Flush floor boxes where indicated shall be complete with the following features:
  - .1 Four (4) independent wiring compartments.

- .2 Flexible activation cover.
- .3 Fully adjustable.
- .4 Sixteen (16) Nos 12.7 mm ( $\frac{1}{2}$  ") – 32 mm ( $1\frac{1}{4}$  ").
- .5 Stamped steel construction (concrete-tight).
- .2 Manufacturers:
  - .1 Wiremold Cat# RFB4-DTB-2-2T-RAKM11- flush floor box complete with two duplex receptacle brackets, 2 dual RJ brackets, and recessed activation with carpet trim plate.
- Approved alternates:
  - .1 Hubbell Cat. #LCFBSS complete with LCFB XX (colour by architect), flush cover and internal faceplate to suit devices noted on the drawings.
  - .2 Wellmark Electric Inc. Cat. #400B-1-YY-XX-CRL.

## 2.6 CONDUIT BOXES

- .1 Cast FS or FD ferrous alloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle **in areas (other than utility rooms) where surface conduit is used.**

## 2.7 FITTINGS- GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm ( $1\frac{1}{4}$  ") and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 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.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1        CSA C22.2 No.65-1956(R1965) Wire Connectors.

**Part 2            Products**

**2.1                MATERIALS**

- .1        Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as indicated.
- .2        Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3        Clamps or connectors for armoured cable, mineral insulated cable, and flexible conduit, as required.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Remove insulation carefully from ends of conductors and:
  - .1        Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2        Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
  - .3        Install fixture type connectors and tighten. Replace insulating cap.

**END OF SECTION**

**Part 1**            **General**  
**Not Applicable.**

**Part 2**            **Products**

**2.1**               **MATERIALS**

- .1       Grounding equipment must conform to CSA C22.2 No 41 (latest edition).

**2.2**               **EQUIPMENT**

- .1       Clamps for grounding of conductor: size as required to electrically conductive underground water pipe and electrically conductive metal gas piping.
- .2       Rod electrodes: copper clad steel 19 mm (3/4") diameter by 3 m (10') long.
- .3       Insulated grounding conductors: green with insulation type that matches specified phase conductors. Gauge shall be in conformance with the latest edition of the Electrical Safety Code to suit required installation conditions.
- .4       Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .5       Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1       Grounding and bonding bushings.
  - .2       Protective type clamps.
  - .3       Bolted type conductor connectors.
  - .4       Thermit welded type conductor connectors.
  - .5       Bonding jumpers, straps.
  - .6       Pressure wire connectors.

**Part 3**            **Execution**

**3.1**               **INSTALLATION GENERAL**

- .1       Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. **Where EMT is used, run ground wire in conduit.**
- .2       Install connectors in accordance with manufacturer's instructions.
- .3       Protect exposed grounding conductors from mechanical injury.
- .4       Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5       Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6       Soldered joints not permitted.

- .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.
- .8 Install separate ground conductor to outdoor lighting standards.
- .9 Ground pad mounted transformers as detailed on the drawings.

### **3.2 ELECTRODES**

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter. This shall apply to the installation or replacement of building water service.
- .2 Install water meter shunt.
- .3 Make ground connections to continuously conductive metal gas piping system. This shall apply to installation or replacement of gas appliances, as well as installation or modification of a building gas piping system.
- .4 Corrugated metal tubing shall not be used as a bonding means for the gas piping system.
- .5 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .6 Install rod or plate electrodes and make grounding connections.
- .7 Bond separate, multiple electrodes together.
- .8 Use #2/0 copper conductors for connections to electrodes. Size in conformance with the Electrical Safety Code.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, and outdoor lighting.

### **3.4 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for telephone, sound, fire alarm, computer network systems as follows:
  - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
  - .2 Sound, fire alarm, computer network systems as indicated.

### **3.5 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Electrical General Requirements Section.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of local authority having jurisdiction over installation.



- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

**END OF SECTION**

**Part 1            General**

**1.1            APPLICATION**

- .1    Seismic restraint is becoming more prominent with improved soil testing equipment. Seismic requirement is not site specific by geographical area but determined by site soil conditions.
- .2    Where the structural engineer or architect documents have  $I_e \cdot S_a(0.2) \cdot F_a < 3.5$  seismic is not required on the electrical systems.
- .3    Where the structural engineer or architect documents have  $I_e \cdot S_a(0.2) \cdot F_a \geq 3.5$  seismic is required on the electrical systems.
- .4    Seismic will always be required on fire protection systems when required by NFPA codes.
- .5    Seismic will always be required on any “Disaster Relief Building.” For example, hospitals, police stations, ambulance building, etc.
- .6    When it is unclear in the tender documents request information from the structural engineer or architect for clarification.

**1.2            SECTION INCLUDES**

- .1    Seismic Requirements for free standing equipment and other similar systems.
- .2    Seismic Requirements for single rod hanger supports for conduit, and other similar systems.
- .3    Seismic Requirements for trapeze type supports for bus tray, conduit, and other similar systems.

**1.3            REFERENCES**

- .1    Building Officials and Code Administrators National Building Code (BOCA) (latest edition).
- .2    Ontario Building Code (OBC), (latest edition).
- .3    Uniform Building Code (UBC), (latest edition).
- .4    International Building Code (IBC), (latest edition).
- .5    California Building Code (CBC), (latest edition).

**1.4            QUALITY ASSURANCE**

- .1    The contractor shall provide pre-engineered seismic restraint systems to meet total design lateral force requirements for support and restraint of free standing electrical equipment, conduit, cable trays and other similar suspended systems and equipment as determined by seismic restraint designer.

- .2 System Supports/Restraints: Firms regularly engaged in the manufacture of products of the types specified in this section, whose products have been in satisfactory use in similar service for not less than 5 years.
- .3 Bolted framing channels and fittings shall have the manufacturers name, part number, and material heat code identification number stamped in the part itself for identification. Material certification sheets and test reports must be made available by the manufacturer upon request.
- .4 Only companies experienced in performing the work of this section shall do the installation.
- .5 All seismic restraint installations shall be independently reviewed by the Owner's representatives for compliance with project specifications.

## **1.5 SUBMITTALS**

- .1 Submit seismic force calculations according to forces chart located on structural engineer of record's drawings. Submit pre-approved restraint selections and installation details from acceptable manufacturer specified in this section or engineer approved equal.
- .2 Restraint selection and installation details shall be pre-approved by a professionally licensed engineer with at least 5 years of experience in the design of seismic restraints.
- .3 Submit manufacturer's product data on strut channels including, but not limited to, types, materials, finishes, gauge thickness, and hole patterns.
- .4 Contractor to retain services of Professional Engineer, designated in local jurisdiction and submit stamped drawings. The same engineer shall provide periodic field review and final certification upon completion of the project.  
The following companies are provided for information purposes:
  - .1 Tecoustics Limited - 1-888-714-9596
  - .2 Lampkin Structural Services – 613-830-6875
  - .3 Vibro Acoustics – 1-800-565-8401
  - .4 Tecoustics Vibration Control & Seismic Restraint – 905-681-6077
  - .5 Gerrits Engineering 705-737-3303
- .5 All fees and associated costs for the engineering shall be the responsibility of this contractor.

## **1.6 SEISMIC BRACING AND SUPPORT DESIGN REQUIREMENTS**

- .1 Seismic restraint designer shall co-ordinate all attachments with the structural engineer of record.
- .2 Design analysis shall include force calculations according to forces chart listed on the structural engineer of record's drawings and capacity of materials utilized for the connection of the equipment or system to the structure.

- .3 Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
- .4 All seismic restraint devices shall be designed to accept without failure the calculated forces as per the applicable Building Code.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver strut systems, pipe hangers and components carefully to avoid breakage, denting, and scoring finishes. Do not install damaged equipment.
- .2 Store strut systems, pipe hangers and components in original cartons and in clean dry space; protect from weather and construction traffic.

#### **1.8 WORK FURNISHED BUT NOT INSTALLED**

- .1 The materials and systems specified in this section shall be purchased by the electrical contractor from a single seismic snubber restraint materials manufacturer to assure sole source responsibility for the performance of the seismic restraints used.
- .2 The materials and systems specified in this section can, at the contractor's option, be installed by the subcontractor who installs the electrical equipment.

#### **1.9 COORDINATION**

- .1 Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting seismically rated equipment. Concrete shall have a minimum compressive strength of 3,000 psi or as specified by the consultant.
- .2 Coordinate with seismic restraint manufacturer to locate and size structural supports underneath seismically restrained equipment (e.g. switchboards, motor control centres, transformers, and other similar equipment).

#### **1.10 DESCRIPTION OF SYSTEM**

- .1 It shall be understood that the requirements of this seismic restraint section are in addition to other requirements as specified elsewhere for the support and attachment of equipment and electrical services, and for the vibration isolation of same equipment. Nothing on the project drawings or specifications shall be interpreted as justification to waive the requirements of this seismic restraint section.
- .2 The work under this section shall include furnishing all labour, materials, tools, appliances, and equipment, and performing all operations necessary for the complete execution of the installation of seismic snubber restraint assemblies as shown, detailed, and/or scheduled on the drawing and/or specified in this section of the specifications.
- .3 All seismic snubber restraint assemblies shall meet the following minimum requirements:
  - .1 The snubber/restrained isolator for isolated equipment shall include a resilient element that will ensure that no un-cushioned shock can occur (this does not include cable restraints).
  - .2 It shall be possible to visually inspect the resilient material for damage and allow for replacement, if necessary.
  - .3 All snubbers are to include a maximum air gap of 0.25" (6 mm).

- .4 Seismic restraint systems shall be designed to offer seismic restraint in all directions, unless otherwise noted.
- .5 Seismic restraint capacities to be verified by an independent test laboratory or certified by a registered Professional Engineer to ensure that the design intent of this specification is realized. Verification shall be by one of the following methods:
  - .1 An NRTL (National Recognized Testing Laboratory), or laboratory recommended by VISCMA.
  - .2 Certified by a Professional Engineer with at least 5 years of experience, using industry standard methods of analysis, which employ common engineering practices. Adherence to the ratings standard within ASHRAE SPC171 and VISCMA 102-2007 is required.
  - .3 By a nationally recognized agency, such as VISCMA, that has reviewed and approved the restraint.

#### **1.11 SYSTEM DESIGN**

- .1 Seismic restraint manufacturer shall be responsible for the structural design of attachment hardware as required to attach snubbers/restraints to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.
- .2 The contractor shall furnish, to the seismic restraint manufacturer, a complete set of approved shop drawings of all equipment that is to be restrained, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings furnished shall include, at a minimum, basic equipment layout, length, and width dimensions, and installed operating weights of the equipment to be restrained.
- .3 All conduit etc. is to be restrained to meet code requirements. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various restraint sizes and anchors, as well as “worst case” reaction loads for each restraint and/or anchor size.
- .4 The contractor shall ensure that all housekeeping pads used are adequately reinforced and are properly dowelled to the building structure, so as to withstand calculated seismic forces. In addition, the size of the housekeeping pad is to be coordinated with the seismic restraint manufacturer to ensure that adequate edge distances exist in order to obtain the desired equipment anchor capacities.

#### **1.12 ALTERNATE SYSTEMS**

- .1 Provisions of the General Conditions and Supplemental Conditions of the specifications shall govern the use of alternate systems to those specified.
- .2 Manufacturers not listed as approved in “Part 2 Materials” of this section must secure approval to bid a minimum of ten (10) days prior to the project bid date.
- .3 Uncertified internal equipment seismic restraint systems are disallowed for use on this project.

## **1.13 INSTALLATION**

- .1 Installation of all seismic restraint materials specified herein shall be accomplished following the manufacturer's written instructions. Installation instructions shall be submitted to the engineer for approval prior to the beginning of the work.

## **Part 2 Products**

### **2.1 ACCEPTABLE MANUFACTURERS**

- .1 Cooper B-Line.
- .2 Unistrut Building Systems.
- .3 Kinetics Noise Control Inc.
- .4 Mason Industries.
- .5 Engineer approved equal.

### **2.2 SEISMIC BRACING COMPONENTS**

- .1 Steel strut and bracing components shall be utilized in combinations as required to meet designed load capacities.
- .2 Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

### **2.3 BUILDING CODE REQUIREMENTS**

- .1 Seismic Zone Factors and coefficients shall be according to geographical area information table located on structural engineer of record's drawings.

### **2.4 SEISMIC SNUBBER TYPES**

- .1 GENERAL  
(Isolator/Snubber Types contained herein are per ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) Handbook, HVAC Applications, Seismic and Wind Restraint Design)
- .2 Type J, Cable Restraints for Suspended Conduit and Trapeze
  - .1 Seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist project seismic loads, arranged to offer seismic restraint capabilities for conduit, trapeze assemblies, and suspended equipment in all lateral directions.
  - .2 Building and equipment attachment brackets at each end of the cable shall be designed to permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points as required to eliminate potential for dynamic cable wear and strand breakage.
  - .3 Restraints shall be sized to the capacity of the cable or to the capacity of the anchorage, whichever is lesser.
  - .4 Seismic wire rope connections shall be made using overlap wire rope "U" clips or seismically rated tool-less wedge insert lock connectors.

- .5 Vertical suspension rods shall be braced as required to avoid potential for buckling due to vertical “up” forces. Braces shall be structural steel angle uniquely selected to be of sufficient strength to prevent support rod bending. Brace shall be attached to the vertical suspension rod by a series of adjustable straps. Clips shall be capable of securely locking brace to suspension rod without the need for hand tools.
- .6 Where clevis hanger brackets are used for seismic restraint attachment, they will be fitted with clevis internal braces to prevent buckling of the hanger brackets.
- .7 Seismic cable shall be as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed.
- .8 Seismic cable building and equipment attachment brackets shall be Model KSCA, KSCU, or KSCC as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed.
- .9 Seismic cable concrete anchor bolts shall be Model KCAB Wedge, Model KCCAB Cracked Concrete, or Model KUAB Undercut, as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed.
- .10 Seismic wire rope connectors shall be (Model KWRC - 'U' clamp) / (Model KWGC - Tool-less wedge lock) as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed.
- .11 Seismic vertical suspension stiffener rod clips shall be Model KHRC as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed.
- .12 Clevis Internal Braces shall be Model KCHB as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 All seismic restraint systems shall be installed in strict accordance with the manufacturer’s seismic restraint guidelines manual and all certified submittal data.
- .2 Installation of seismic restraints shall not cause any change in position of equipment or piping, resulting in stresses or misalignment.
- .3 No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration isolation system specified.
- .4 Do not install any equipment, piping, duct, or conduit that makes connections with the building unless isolation is not specified.
- .5 Prior to installation, bring to the architect’s/engineer’s attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- .6 Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or wedge-type concrete anchors. Consult structural engineer of record.

- .7 Overstressing of the building structure shall not occur from overhead support of equipment. Bracing attached to structural members may present additional stresses. The contractor shall submit loads to the structural engineer of record for approval in this event.
- .8 Brace support rods when necessary to accept compressive loads. Welding of compressive braces to the vertical support rods is not acceptable.
- .9 Provide reinforced clevis bolts where required.
- .10 Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
- .11 Do not brace a system to two independent structures such as a ceiling and wall.
- .12 Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- .13 Torque anchor bolts according to anchor manufacturer's written instructions to resist seismic forces.
- .14 Do not install any seismic restraint for equipment, cable trays or conduit that compromises isolation specified.
- .15 Hold down clamps must be used to attach conduits and/or cables to all trapeze members before applying restraints.
- .16 Conduit crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the conduit, equipment connections, or support connections. Conduit offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent piping.
- .17 Coring is not permitted for the installation of concrete anchors. Use ground penetrating radar or equivalent method of embedment item detection to locate all embed items including reinforcing steel and electrical conduits. Concrete reinforcing steel and electrical conduits shall not be cut or damaged under any circumstances.

### **3.2 EXECUTION**

- .1 Install vertical braces to stiffen hanger rods and prevent buckling per seismic restraint manufacturer's design. Clamp vertical brace to hanger rods. Requirements apply equally to hanging equipment. Do not weld vertical braces to hanger rods.
- .2 If mounting hole diameter exceeds bolt diameter by more than 0.125" (3 mm), reduce clearance in hole with epoxy grout, flanged elastomeric bushings or welded washer.
- .3 Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors. Refer to seismic restraint manufacturer's written instructions.



### **3.3 INSPECTION**

- .1 The contractor shall notify the local representative of the seismic restraint materials manufacturer prior to installing any seismic restraint devices. The contractor shall seek the representative's guidance in any installation procedures with which he/she is unfamiliar.
- .2 Upon completion of the installation of all seismic restraint devices herein specified, the local representative of the seismic restraint manufacturer shall, at the contractor's request, inspect the completed system and report in writing any installation errors, improperly selected snubber devices, or other fault in the system which could affect the performance of the system.
- .3 The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

### **3.4 CONDUIT**

- .1 Seismically restrain all electrical conduit. Use Type J Cable Restraints for all conduit supported by vibration isolation hanger assemblies. Brace all conduit to code requirements (IBC or TI-809-04) or in conformance with SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition (Remaining Codes).

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
  - .2 CSA C22.2 No.45-M1981(R1992), Rigid Metal Conduit.
  - .3 CSA C22.2 No.56-1977(R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No.83-M1985(R1992), Electrical Metallic Tubing.
  - .5 CSA C22.2 No.211.2-M1984(R1992), Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No.227.3-M91, Flexible Nonmetallic Tubing.

**Part 2 Products**

**2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No.45, aluminum threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No.45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT) with couplings: to CSA C22.2 No.83.
- .4 Rigid PVC conduit: to CSA C22.2 No.211.2.
- .5 Flexible metal conduit: to CSA C22.2 No.56, aluminum and liquid-tight flexible metal.
- .6 Flexible PVC conduit: to CAN/CSA C22.2 No.227.3, ENT.

**2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 53 mm (2") and smaller. Two hole steel straps for conduits larger than 53 mm (2").
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m (5'-0") oc.
- .4 Threaded rods, 6 mm (1/4") diameter, to support suspended channels.

**2.3 CONDUIT FITTINGS**

- .1 EMT fittings shall be set screw style (zinc alloy).
- .2 Flexible metal conduit fittings shall be screw-in type.
- .3 Liquid type flexible metal conduit fittings shall be sealtite type.
- .4 PVC fittings shall be PVC type complete with PVC adaptors at all boxes.
- .5 Rigid conduit and mineral insulated conduit fittings shall be threaded type.
- .6 Coating: same as conduit.

- .7 Factory "ells" where 90° bends are required for 27 mm (1") and larger conduits.
- .8 Where bushings are noted to be provided they must be "screwed" type fastened to a conduit connector. Push-fit or glued in place bushings will NOT be accepted.

## **2.4 FISH CORD**

- .1 Nylon twine.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical/ electrical service rooms and in unfinished areas.
- .3 Use electrical metallic tubing (EMT) for all branch circuits unless specified otherwise.**
- .4 Use rigid aluminum threaded conduit where specified and up to 2.1 m (7'-0") above finish floor where exposed to mechanical injury.
- .5 Use rigid PVC conduit underground and in kitchen areas.
- .6 Use flexible metal conduit for connection to motors in dry areas, connection to recessed fixtures without a prewired outlet box, connection to surface or recessed fixtures, work in movable metal partitions.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations and for connections to kitchen equipment.
- .8 Conduits terminating at electrical equipment in sprinklered areas are to be provided with insulated compression style connectors equal to Thomas & Betts Cat. #TC8XXSC or approved equal.
- .9 Minimum conduit size for branch circuits shall be 21 mm (3/4").** Single drops from ceiling mounted junction boxes down to a light switch or duplex receptacle may be reduced to 16 mm (½").
- .10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .11 Mechanically bend steel conduit over 27 mm (1") diameter.
- .12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .13 Install fish cord in empty conduits.
- .14 Run 2- 27 mm (1") spare conduits up to accessible ceiling space from each flush panel. Terminate these conduits in 152 mm x 152 mm x 102 mm (6" x 6" x 4") junction boxes in ceiling space.
- .15 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.
- .17** Install conduit sealing fittings in hazardous areas. Fill with compound.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m (5') clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.
- .7 **Do not fasten surface conduit to roof deck. Provide standoffs or supports as manufactured by Caddy or use unistrut trapeze fastened to structure.**

### **3.3 CONCEALED CONDUITS**

- .1 Do not install horizontal runs in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings.

### **3.4 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 27 mm (1") concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

### **3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE**

- .1 Run conduits 27 mm (1") and larger 300 mm (12") below slab (measured from top of slab to bottom of conduit) and encased in 78 mm (3") sand envelope.

### **3.6 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL PROVISIONS**

- .1 Conform to the General Provisions of Division 1 and Electrical General Requirements Section.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Electrical General Requirements Section.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Rigid PVC ducts must conform to CSA C22.2 No. 211.0, 211.1 and 211.2 (latest edition).
- .2 Ducts and/or cables must be excavated, bedded, reinforced, encased and backfilled as per details on the drawings.

**2.2 DUCT**

- .1 Ducts indicated for encasement in concrete must be type DB-2. Ipex “Super Duct” or approved equal.
- .2 Ducts indicated for direct burial must be type SCEPTER. Ipex “Scepter” rigid PVC duct or approved equal.

**2.3 DUCT FITTINGS**

- .1 Fittings required to provide a complete continuous ductbank installation shall include but not be limited to, couplings, bell end fitting, caps, adapters, base and intermediate spacers.
- .2 Small or large angle couplings will be required where noted on the drawings.
- .3 Expansion joints are to be provided when running ducts in concrete across expansion joints and where exposed on roofs or exterior of buildings.

**Part 3 Execution**

**3.1 BASIC INSTALLATION**

- .1 Excavate trench along route as indicated and at a depth to suit cables and/or ducts as detailed.
- .2 If required, trench is to be pumped to maintain excavation free of water.
- .3 Import granular fill and place in bottom of trench. Compact to provide a firm level base.
- .4 Quantity and arrangement of ducts must be provided according to drawing details.
- .5 When ducts terminate at buildings or precast bases provide bell end fittings.

- .6 When terminating a ductbank for future extension terminate each duct with a coupling. If ducts are encased in concrete set coupling flush with end of concrete.
- .7 Attach ducts to spacers using non-metallic materials.
- .8 Provide concrete as detailed. Pour concrete down sides of ductbank to ensure spaces around and under ducts are filled first.
- .9 Concrete must obtain 50% of its specified strength prior to backfilling.
- .10 Backfilling must be imported granular 'A' material.**
- .11 Backfill must be placed as 150 mm (6") compacted lifts.
- .12 Excess excavated material must be removed from site by this contractor.
- .13 Ensure ducts indicated to be installed along a curb line are installed at least 600 mm (24") from that curb line.

### 3.2 DIRECT BURIAL OF DUCTS

- .1 After sand bed specified is in place, lay ducts maintaining 75 mm (3") clearance from each side of trench to nearest duct. Do not pull cable into trench.
- .2 Provide offsets for thermal action and minor earth movements. Offset ducts 150 mm (6") for each 60 m (200') run, maintaining minimum duct separation and bending radius requirements.
- .3 Underground cable splices not acceptable.
- .4 Duct separation:
  - .1 Provide separation of ducts in conformance with the details in the Electrical Safety Code.

### 3.3 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

### 3.4 FIELD QUALITY CONTROL

- .1 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .2 Check phase rotation and identify each phase conductor of each feeder.

- .3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 mega ohms.
- .4 Pre-acceptance tests.
  - .1 After installing cable but before terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
- .5 Provide Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.
- .6 Remove and replace entire length of cable if cable fails to meet any of test criteria.
- .7 The Consultant requires a minimum of 48 hours notice to inspect at his discretion the following; ductbank excavation, bedding and duct placement, pouring and/or placement of ductbank encasement.**

**END OF SECTION**

## **Part 1            General**

### **1.1            GENERAL REQUIREMENTS**

- .1      The studies must be submitted to the Consultant prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Consultant may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.
- .2      The studies shall include all portions of the electrical distribution system from the normal power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system, **as well as mechanical unit equipment**. Normal system connections and those, which result in maximum fault conditions, shall be adequately covered in the study.
- .3      The firm should be currently involved in high- and low-voltage power system evaluation. The study must be performed, stamped and signed by a registered professional engineer in the Province of Ontario. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Consultant for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.
- .4      The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

### **1.2            DATA COLLECTION FOR THE STUDY**

- .1      The Contractor shall provide the required data for preparation of the studies. The Consultant performing the system studies shall furnish the Contractor with a listing of the required data immediately after award of the contract.
- .2      The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.
- .3      Data collected for the study, including correspondence with local utility, shall be included with study report.

## **Part 2            Products**

### **2.1            SHORT CIRCUIT AND PROTECTIVE DEVICE EVALUATION AND COORDINATION STUDY**

- .1      The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.



- .2 In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.
- .3 In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
- .4 Include on the curve sheets power company relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. In addition, include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.  
Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.
- .5 Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.
- .6 Include complete fault calculations as specified herein based on contract documents.
- .7 Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit the study to Consultant for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer.

- .8 Utilize equipment load data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.
- .9 Include fault contribution of all motors in the study. Notify the Consultant in writing of circuit protective devices not properly rated for fault conditions.
- .10 When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Contractor shall obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.
- .11 Evaluate proper operation of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
- .12 For motor control circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current and time to ensure protective devices will not trip during major or group start operation.
- .13 **Evaluate proper rating of applicable mechanical unit equipment based on available fault at unit connection. Mechanical unit equipment in study shall include packaged assemblies identified as, but not limited to, AHUs, MUAs, DOAS, Chillers, and Cooling Towers.**

## 2.2 ARC FLASH HAZARD ANALYSIS

- .1 The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D and CSA Z462-(latest edition).
- .2 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- .3 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
- .4 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- .5 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
- .6 Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm<sup>2</sup>.
- .7 The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

- .8 Arc Flash computation shall include both line and load side of main breaker calculations, where necessary.
- .9 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-latest edition section B.1.2.
- .10 Arc Flash computation shall include arc flash current magnitude at each circuit breaker 1200A or higher (ARMS capable) to allow the Arc Flash Reduction Maintenance System pickups to be set based on multiples of the per unit secondary arc current monitored by the trip unit.

### 2.3 STUDY REPORT

- .1 The results of the power system study shall be summarized in a final report. Submit report in accordance with Electrical General Requirements Section as a shop drawing.
- .2 The report shall include the following sections:
  - .1 Descriptions, purpose, basis, and scope of the study.
  - .2 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
  - .3 **Tabulations of mechanical unit equipment ratings as identified on equipment shop drawings versus calculated short-circuit, and commentary regarding same. Short-circuit calculations for mechanical equipment shall be based on unit MCA with conductor sizes as identified on electrical design drawings and not based on equipment MOC.**
  - .4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
  - .5 Fault current calculations including a definition of terms and guide for interpretation of computer printout.
  - .6 Incident energy and flash protection boundary calculations
    - .1 Arcing fault magnitude
    - .2 Device clearing time
    - .3 Duration of arc
    - .4 Arc flash boundary
    - .5 Working distance
    - .6 Incident energy
    - .7 Hazard Risk Category
    - .8 Recommendations for arc flash energy reduction
    - .9 **Recommendations for Personal Protection Equipment (PPE) level.**

**Part 3            Execution**

**3.1            POWER COMPANY APPROVAL**

- .1       Copies of the final report must be submitted to the power company for their review and approval. Approved copies of the report shall be submitted to the Consultant.

**3.2            FIELD SETTINGS**

- .1       The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, and protective device coordination study.
- .2       Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.
- .3       At the completion of the project, configure settings and install equipment labels. On company letterhead, the contractor is to prepare a certification letter indicating at minimum:
  - .1       project
  - .2       date
  - .3       device designation
  - .4       certification of correct settings
  - .5       certification of correct device labels
  - .6       certification of arc flash hazard equipment labels
  - .7       digital image of each breaker indicating final settings and placement of labels

**3.3            ARC FLASH WARNING LABELS**

- .1       The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2       The label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD", and shall include the following information:
  - .1       Location designation
  - .2       Nominal voltage
  - .3       Flash protection boundary
  - .4       Hazard risk category
  - .5       Incident energy
  - .6       Working distance
  - .7       Personal Protection Equipment (PPE) level
  - .8       Engineering report number, revision number and issue date.

- .3 Labels shall be machine printed, with no field markings.
- .4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
  - .1 For each 600 and applicable 208 volt panelboards, one arc flash label shall be provided.
  - .2 For each low voltage switchboard, one arc flash label shall be provided.
  - .3 For each switchgear, one flash label shall be provided.
- .5 **Labels shall be field installed by the firm providing the Arc Flashing Hazard Analysis.**

### **3.4 SERIES RATING LABELS**

- .1 Provide Iamcooid labels where recommended by study. **Labels for series rating with panelboards or equipment shall be indicated on feeder breaker as “SERIES RATING BREAKER” and at the panelboard or equipment as “SERIES RATING EQUIPMENT”. Refer to section 26 24 16.**

### **3.5 ACCEPTABLE TESTING FIRMS**

- .1 MVA Engineering (519) 668-4698
- .2 GT Woods (905) 272-1696
- .3 Brosz & Associates (905) 472-6660
- .4 K-Tek Electro-services Ltd. (905) 640-0660 ext. 228

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS**

- .1 Submit shop drawings for each system in Conformance with The Electrical General Requirements Section.

**1.2 PRODUCT/MAINTENANCE DATA**

- .1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to The General Electrical Requirements Section.

**1.3 SCOPE**

- .1 The scope of this Section will include the following systems.
  - .1 Hand dryers.
  - .2 Cable management hangers.
  - .3 Cable management system.
  - .4 Auxiliary systems rough-in.
  - .5 Security and access control rough-in.
  - .6 Telecommunication network system rough-in.
  - .7 Destratification fans and controls.
  - .8 Cable reels.

**Part 2 Products**

**2.1 HAND DRYERS**

- .1 Hand dryers where noted on the drawings are to be supplied and installed by this Division with the following features:
  - .1 Surface mounting.
  - .2 Stainless Steel finish with automatic activation.  
Final finish selection by owner/architect.
  - .3 Rating of 1000 W at 120 V.
  - .4 Dyson Cat. #HU02-XX

**2.2 CABLE MANAGEMENT HANGERS**

- .1 Hangers where noted are to be complete with the following features:
  - .1 Approximately 150 mm (6") high by 80 mm (3¼") protrusion.
  - .2 Constructed from 5 mm (3/16") x 20 mm (3/4") flat steel bar and formed to resemble the letter "G".
  - .3 Seven 6 mm (1/4") diameter mounting holes are to be provided around the hanger perimeter.

- .4 Matte black finish.
- .5 Suitable for wall or suspended mounting.
- .6 Acceptable Manufacturers:
  - .1 EMF Cat. #H-533-S
- .7 Manufacturer Contact:  
Electron Metal Fabricators Inc.  
2160 Dagenais Boulevard West  
Laval, Quebec  
H7L 5X9  
Phone: 450-625-8064 or 1-800-267-8064  
Fax: 450-625-8004
- .8 Acceptable Alternate:  
Wiremold Cat. #GH030406  
Mono System Cat. # The Hook H-433  
Cablofil Cat. #CSGH-3-4-6  
Eaton Cat. #B-Line
- .2 **As an alternate to the hanger system detailed the contractor may**  
**a) Use as an equal one run of 50 mm (2") x 150 mm (6") wire mesh cable management**  
**system equal to Cablofil Cat. #CF 54/150 EZ complete with Cat. #FAS L 150 universal**  
**wall bracket where noted to be wall mounted and Cat. # FAS C 200 where noted to be**  
**hung. The hangers are to be installed at intervals as recommended by the**  
**manufacturer but no greater than 2.4 m (8'-0") on centre.**

### 2.3 CABLE MANAGEMENT SYSTEM

- .1 The system where noted shall be a continuous, rigid, welded steel wire mesh cable management system with the following features:
  - .1 Permits continuous ventilation of cable and maximum dissipation of heat.
  - .2 Continuous safety edge T-welded wire lip.
  - .3 Welded at all intersections.
  - .4 Straight sections 4" x 12" (100 mm x 300 mm) in configurations noted on the drawings.
  - .5 Constructed of carbon steel wire, ASTM A 510, grade 1008. Wire welded, bent, and surface treated after manufacture.
  - .6 Post fabrication finish of electro-plated zinc galvanizing: ASTM B 633, Type III, SC-1.
  - .7 Fittings: Field fabricated in accordance with manufacturer's instructions from straight sections.
- .2 The support system shall be Cablofil FAS CH hanger.
- .3 The necessary hardware, including splice connectors and support components furnished by manufacturer.

.4 The product shall be Cablofil Cat. #CF105/300EZ complete with Cat. #FAS P300 CH at intervals as recommended by the manufacturer.

.5 The manufacturer shall be:

.1 Cablofil Inc.  
Local representation by:  
Cablofil  
533 Galway Drive  
Burlington, Ontario  
L7L 2S6  
Ph: 905-681-5380  
Fax: 905-681-2206

.6 Approved equals:

.1 Eaton B-Line FT4x12x10 complete with 12 CTR HGR  
Intralec Electrical Products Ltd.  
1200 Cardiff Blvd.  
Mississauga, Ontario  
L5S 1P6  
Phone: 905-670-0970

## **2.4 AUXILIARY SYSTEMS ROUGH-IN**

- .1 Outlets where noted shall be single gang boxes unless specified otherwise.
- .2 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.
- .3 Coordinate final outlet locations, quantities, etc. with respective system vendor and owner's representative.

## **2.5 SECURITY AND ACCESS CONTROL ROUGH-IN**

- .1 Provide conduit from device and outlet locations to cable management systems as noted on drawings.
- .2 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.
- .3 Provide grounding of equipment as noted on drawings.

## **2.6 TELECOMMUNICATION NETWORK SYSTEM ROUGH-IN**

- .1 Outlets where noted shall be single gang flush mounted in wall or surface raceways.
- .2 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.
- .3 Provide a #6 insulated green ground conductor from main service ground to voice equipment backboard located on drawings.



## **2.7           DESTRATIFICATION FANS AND CONTROLS**

- .1   General purpose fans in the gym to be provided with the following features:
  - .1   Metal construction.
  - .2   Baked white enamel.
  - .3   Down-blowing single direction.
  - .4   1400 mm (56") diameter blade combination.
  - .5   Minimum 400 mm (16") suspension with ball aligner and canopy.
  - .6   Suitable for 120V/1/60Hz operation.
  - .7   Provided with wire cage.
  - .8   Manufacturer:
    - .1   Banvil Cat. #60F9-10 (FG60C where noted).
- .2   Multiple fan variable speed controller shall be Banvil Cat. [#105F (up to 4 fans), 150F (up to 8 fans), or 200F (up to 12 fans)] c/w colour and coverplate to suit this specification.
- .3   Approved equal:
  - .1   Pleasantaire

## **2.8           CABLE REELS**

- .1   Cable reels are to be provided with the following features.
  - .1   Steel frame and yellow powder coat finish.
  - .2   Heavy duty welded mounting frame.
  - .3   Multi-position guide arm.
  - .4   Multi-directional nylon rollers on guide arm.
  - .5   12 AWG 3 conductor-SJEO cord.
  - .6   Positive-latch mechanism.
  - .7   Automatic spring retraction.
  - .8   Plug in power cord.
  - .9   Complete with FS type box, specification grade duplex receptacle and weatherproof cover.
  - .10   Must conform to UL 355/CSA C22.2 No. 21-M90.
  - .11   Acceptable Material:
    - .1   Hubbell Cat. #HBLI45123R20Y.
  - .12   Acceptable Alternate:
    - .1   Woodhead

## **Part 3       Execution**

### **3.1       HAND DRYERS**

- .1   Install and connect hand dryers in conformance with manufacturer's recommendations.

- .2 Hand dryers are to be mounted at a height to suit age of expected users. Unless otherwise noted confirm height with manufacturer, owner, Architect, and/or consultant prior to rough-in.
- .3 Once installed this contractor is to caulk the joint between dryer and wall surface with a bead of clear silicone.

### **3.2 CABLE MANAGEMENT HANGERS**

- .1 Install hangers as per details in configuration noted.
- .2 Prior to installation coordinate location with other services within the ceiling space.
- .3 Coordinate with noted sub-contractors to install cables noted to be utilizing these hangers. Cables are to be installed such that the maximum sag between hangers does not exceed 25 mm (1"). This electrical contractor is to coordinate.
- .4 **Attaching cable to any T-bar support rods is not acceptable.**

### **3.3 CABLE MANAGEMENT SYSTEM**

- .1 Install cable management system at locations indicated on the drawings and in accordance with manufacturer's instructions.
- .2 Support system every 2.4 m (8'-0") unless system is used within a telecommunication room. In that situation support every 1.5 m (5'-0").
- .3 Cut wires in accordance with manufacturer's instructions.
- .4 Cut wires with side action bolt cutters to ensure integrity of galvanic protective layer. Cut using side action bolt cutters (Cablofil Cat. #Coupfil).
- .5 Cut each wire with 1 clean cut to eliminate grinding or touch-up.
- .6 Install cable management system using hardware, splice connectors, support components, and accessories furnished by manufacturer.
- .7 Suspend from structure or intermediate Unistrut channel spanning across the corridor where access to structure is not available due to the concentration of mechanical ductwork and/or piping.
- .8 Ground cable tray with continuous ground per O.E.S.C. and manufacturer instructions. Test to ensure minimum 5 ohms resistance.
- .9 Locate cable management system minimum 9" from EMI sources including but not limited to fluorescent lights, transformers, motors, and power cables.

### **3.4 AUXILIARY SYSTEMS ROUGH-IN**

- .1 Provide backboard for each system use as noted complete with ground buss connection as specified.
- .2 Outlets are to be installed complete with minimum 21 mm (3/4") conduit to accessible ceiling space or as otherwise detailed.
- .3 Conduits terminated into ceiling spaces must be within 3 m (10') of zone conduits when noted.

- .4 Provide insulated bushings on all conduits terminated in ceiling space.
- .5 Ensure specified zone or riser conduits are installed back to equipment backboard.

### **3.5 SECURITY AND ACCESS CONTROL ROUGH-IN**

- .1 Outlets are to be provided for devices with conduit as detailed on drawings.
- .2 Conduits terminated into ceiling spaces must be within 1m of cable management of tray.

### **3.6 TELECOMMUNICATION NETWORK SYSTEM ROUGH-IN**

- .1 Install incoming service ducts and terminate as noted.
- .2 Provide backboard as noted complete with ground connection to main service ground.
- .3 Conduits terminated into ceiling spaces must be within 3m (10') of zone conduits (if applicable).
- .4 Ensure specified zone conduits are installed back to service backboard.
- .5 Outlets are to be installed complete with 25 mm (1") conduit to corridor ceiling space or nearest zone conduit (if applicable).
- .6 Provide insulated bushings on all conduits terminated in ceiling space.

### **3.7 DESTRATIFICATION FANS AND CONTROLS**

- .1 Ensure fans and controls are installed in conformance with manufacturer recommendations.
- .2 Install wireguards to be level. Fasten wireguards to structure NOT roof deck. Provide intermediate Unistrut supports to suit.
- .3 Demonstrate fan operation at the time of final inspection.

### **3.8 CABLE REELS**

- .1 Install as per manufacturer instructions securely to ceiling.
- .2 Install duplex receptacle adjacent and connect to circuit noted.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Heaters must conform to CSA 22.2 No.46 (latest edition).

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with the Electrical General Requirements Section.
- .2 Product data to include:
  - .1 Suspension of heating element.
  - .2 Physical size.
  - .3 Thermostat control if integral.
  - .4 Finish.
  - .5 kW rating, voltage, phase.
  - .6 Cabinet thickness.
  - .7 Cabinet surface temperature.
  - .8 Mounting methods.
  - .9 Auxiliary controls.
  - .10 Replacement data for motor element, thermostat, and switch.

**1.3 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for all heating system components for incorporation into manual as specified in the Electrical General Requirements Section.

**Part 2 Products**

**2.1 UNIT HEATERS**

- .1 Unit heater shall be horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters must be provided with built-in high-heat limit protection.
- .3 Fan motor must be permanently lubricated ball bearing type with resilient mount. Built-in fan motor thermal overload protection.
- .4 Hangers shall be as indicated on drawings.
- .5 Elements shall be mineral insulated copper coated steel sheath with aluminum brazed fins.
- .6 Cabinet shall be steel fitted with brackets for rod or wall mounting. Phosphatized and finished with baked enamel finish to suit architect.

- .7 Controls shall be (as indicated) either wall mounted remote thermostats or integral 2 pole thermostats to control load of heater specified. Integral magnetic contactors (if specified) are to be provided to suit load.
- .8 For the purposes of bidding, electrical trade shall include but not be limited to provision of a junction box to connect equipment wiring tail, provision of suitable disconnecting means, and flexible connection directly to equipment.

## **2.2 FORCED AIR WALL HEATERS**

- .1 Forced air wall heaters, wall or ceiling mounted as noted complete with T-bar mounting frame. Heater shall be commercial type as follows:
  - .1 Enclosure:
    - .1 Steel: 18 gauge.
    - .2 Knockouts for 19 mm (3/4") diameter conduit left, right, bottom and rear.
    - .3 Grill and frame finished to suit architect.
  - .2 Elements and Fan:
    - .1 Mineral insulated.
    - .2 Motor: totally enclosed, shaded pole, impedance protected motor.
- .2 Controls:
  - .1 Built-in tamperproof controls. 'On-Off-Fan Only' selector switch and temperature control knob.

## **2.3 THERMOSTATS**

- .1 Line voltage thermostats in finished areas as indicated shall be complete with the following features:
  - .1 Full load rating of maximum 18 A at 208 V
  - .2 Temperature range: 10°C to 27°C (50°F to 80.6°F)
  - .3 Temperature range shall be marked on face of thermostat in 5 degree increments.

## **2.4 APPROVED MANUFACTURERS**

- .1 Approved manufacturers shall be:
  - .1 Ouellet
  - .2 Stelpro
  - .3 Westcan

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Suspend unit heaters from ceiling or mount on wall as indicated. Provide local disconnecting means. Provide unfused disconnect for each unit heater.

- .2 Install force flow heaters as indicated.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Electrical General Requirements Section.
- .2 Ensure that heaters and controls operate correctly.
- .3 On fan powered units:
  - .1 Test cut-out protection when air movement is obstructed.
  - .2 Test fan delay switch to assure dissipation of heat after element shut down.
  - .3 Test unit cut-off when fan motor overload protection has operated.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Dry type transformers must conform to CSA C22.2 No.47 and C9 (latest edition).
- .2 **Dry type transformers must conform to CSA C802 (latest edition).**
- .3 **Dry type transformers must be in accordance with Ontario Green Energy Act 2018 (NRCan 2018) DOE 2016.**

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Electrical General Requirements Section.

**Part 2 Products**

**2.1 TRANSFORMERS**

- .1 Transformers to be of one manufacturer throughout project.
- .2 Ratings and characteristics shall be as indicated on riser diagrams.
- .3 Aluminum winding.
- .4 Transformers are to be ventilated dry type style with 4-2½% taps (2 F.C.B.N. and 2 F.C.A.N.)
- .5 Maximum permissible sound levels shall be as follows:

Transformer Rating (KVA)	Sound Level (dBA)
≤50	45
51 to 150	50

- .6 Transformer enclosure shall be EEMAC/NEMA 3R ventilated complete with removable front panel.
- .7 Provide vibration isolators equal to Korfund R series, Mason ND-B, or approved equal. "Colour" of vibration isolators shall be based on weight of transformers.

Transformer Weight (lbs)	Approximate Rating	Colour (Korfund)
540	15 – 75 kVA	Blue (RD2)
680	112.5 kVA	Black (RD2)
960	150 kVA	Red (RD2)

## **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Label must indicate:
  - .1 transformer “tag” as per riser diagram
  - .2 primary and secondary voltage and phase.

## **2.3 ACCEPTABLE MANUFACTURERS:**

- .1 Acceptable manufacturers are as follows:
  - .1 Hammond
  - .2 Rex
  - .3 Delta
  - .4 Acme
  - .5 Bemag

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Primary and secondary feeders are to be connected using flexible conduit.
- .2 Transformers with a rating up to and including 75 KVA are permitted to be wall mounted provided mounting method is a suitably sized angle iron frame secured to structure (i.e. masonry wall, steel columns, etc. NOT metal siding).
- .3 The above rating of transformers may also be suspended from **structure only** on a unistrut trapeze as detailed.
- .4 Transformers above 75 KVA must be floor mounted.
- .5 Floor mounted transformers are to be mounted/secured to a concrete pad suitably sized to suit the transformer. This pad is the responsibility of this contractor and must be provided in conformance with the standard of Division 1 specifications for poured in place concrete.
- .6 All transformers must be mounted on vibration isolators selected based on transformer weight.
- .7 Ensure adequate clearance around transformer for ventilation as per the Electrical Safety Code.
- .8 Loosen isolation pad bolts until no compression is visible.
- .9 Install transformers in level upright position.
- .10 Remove shipping supports only after transformer is installed and just before putting into service.



- .11 Make primary and secondary connections in accordance with wiring diagram.
- .12 Energize transformers after installation is complete.

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Electrical General Requirements Section.
- .2 Indicate on shop drawings.
  - .1 Floor anchoring method and foundation template.
  - .2 Dimensioned cable entry and exit locations.
  - .3 Dimensioned positions and size of bus.
  - .4 Overall length, height and depth.
  - .5 Dimensioned layout of internal and front panel mounted components.

**1.2 MAINTENANCE DATA**

- .1 Provide maintenance data for service entrance board for incorporation into manual specified in the Electrical General Requirements Section.
- .2 Submit 5 copies of maintenance data for complete assembly including components.

**1.3 MAINTENANCE MATERIALS**

- .1 Include:
  - .1 One can of touch-up paint.

**1.4 SOURCE QUALITY CONTROL**

- .1 Consultant to witness final factory tests if requested.
- .2 Notify Consultant in writing 5 days in advance that service entrance board is ready for testing.
- .3 Submit 5 copies of certified test results.

**Part 2 Products**

**2.1 SERVICE ENTRANCE BOARD**

- .1 Service entrance board must conform to CSA C222 No. 31 (latest edition).
- .2 Rating: 347/600V, 3 phase, 4 wire, 400A, short circuit current (kA rms symmetrical as noted on distribution riser).
- .3 Cubicles: wall-mounted/free standing, dead front, size as indicated, hinged access panels with captive knurled thumbscrews (front access only), EEMAC2 rating (sprinkler hood).

- .4 Main section to contain:  
Breakers as noted complete with kA interrupting capacity to match mains.  
Barriered section for supply authority metering components.  
Digital metering unit as specified.  
NOTE: Refer to Moulded Case Circuit Breakers section for specifications regarding the required breakers.
- .5 Distribution section to contain breakers as noted complete with kA interrupting capacity to match mains.  
NOTE: Refer to Moulded Case Circuit Breakers section for specifications regarding the required breakers.
- .6 Bus bars and main connections: aluminum.
- .7 Bus bars from load terminals of main device through metering section to distribution section.
- .8 Bus bars are to have identified colour coded phases.

## **2.2 GROUNDING**

- .1 Aluminum ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for grounding cable. Contractor to size lug.

## **2.3 POWER SUPPLY AUTHORITY METERING**

- .1 Separate compartment and rigid metal raceway for exclusive use of power supply authority metering.
- .2 Mounting accessories and wiring for metering supplied by power supply authority:
  - .1 3 current transformers.

## **2.4 FINISHES**

- .1 Apply finishes in accordance with the Electrical General Requirements Section.
  - .1 Service entrance board exterior: grey.

## **2.5 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Nameplates:
  - .1 Black plate, white letters, and size 7.
  - .2 Complete board labeled: 347/600V.
  - .3 Main disconnect labeled: Main Breaker
  - .4 Branch disconnects labeled: as indicated.

## **2.6 ACCEPTABLE PRODUCTS**

- .1 Quick Ship
  - .1 Eaton Cat# CMP Series
  - .2 Siemens Cat# SMP
  - .3 Schneider Electric Cat# MDS
- .2 Digital Metering Units
  - .1 Eaton Cat# IQ 260 (MOD BUS) or Power Xpert 2000 Series (BACnet)
  - .2 Siemens Cat# PAC 4200
  - .3 Schneider Electric Cat# PM-5563RD.
- .3 Digital metering units shall be complete with MOD BUS (BACnet) communication module for interface of monitored parameters to BAS. Coordinate output with BAS contractor.
- .4 Manufacturer is to include for representative to visit the site to fully commission the meter.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate service entrance board and fasten to wall/housekeeping pad.
- .2 Connect main secondary service to line terminals of main device.
- .3 Connect load terminals of distribution devices to feeders.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run grounding conductors from ground bus to building ground to suit the Electrical Safety Code.
- .6 Check trip unit settings against co-ordination study to ensure proper working and protection of components.
- .7 Co-ordinate with local supply authority and board manufacturer for shipment and installation of metering components at board manufacture's fabrication plant.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Electrical General Requirements Section.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**Part 2 Products**

**2.1 PANELBOARDS**

- .1 Panel boards must conform to CSA C22.2 No. 29 (latest edition).
- .2 Panelboards: product of one manufacturer.
- .3 Install circuit breakers in panelboards before shipment.
- .4 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand. **Series rating is acceptable – submit information with shop drawings. Provide lamicoid label on feeder breaker. Lamicoid label to state "Series Rating Breaker." Lamicoid label to be size 2.**
- .5 Bus and breakers must be rated for 10,000 A (symmetrical) interrupting capacity or as indicated.
- .6 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.
- .7 Panelboard mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .8 Two keys for each panelboard and key panelboards alike.
- .9 Aluminum bus with neutral of same ampere rating as mains.
- .10 Mains must be suitable for bolt-on breakers. Provide main (if applicable) and branch breakers as bolt-on style.
- .11 Trim with concealed front bolts and hinges.
- .12 Trim and door finish must be baked grey enamel.
- .13 All panels regardless of voltage and amperage must be provided with a lockable door.
- .14 Branch circuit panelboards (250 AMP or smaller) must be one of the following:
  - .1 Eaton Cat # POW-R-LINE-C PRL-1 or PRL-2
  - .2 Schneider Electric Cat # NQ Series for up to 240V or NF Series for up to 600V
  - .3 Siemens Cat #Sentron P1 Series

- .15 Branch circuit panelboards indicated to be complete with an external surge protective device shall include a suitably sized branch circuit breaker for the surge protective device as noted on panel schedule, and per surge protective device manufacturer recommendations. Surge protective device shall be provided as specified in section 26 43 13, unless noted otherwise.

## **2.2 BREAKERS**

- .1 Breakers: to Moulded Case Circuit Breakers Section.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Lock-on devices for fire alarm, stairway, exit and night light circuits.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Nameplate for each panelboard size 4 engraved description as indicated. In finished areas install label on inside of panel, and in service areas install label on exterior of panel.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved "name of load" as indicated.
- .4 Complete circuit directory with typewritten legend showing location of each circuit.  
**Include a copy of the directories in the maintenance manuals.**

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard. Plywood shall be 21 mm (3/4") fire rated or painted with intumescent fire block paint having a minimum of 1h rating, unless noted otherwise.
- .3 Mount panelboards to height specified in Electrical General Requirements Section or as indicated.
- .4 Connect loads to circuits.

- .5 Connect neutral conductors to common neutral bus.
- .6 Mount external surge protective devices as close as possible to panelboard and associated branch breaker to minimize lead lengths and per manufacturers recommendations. Provide modified panel trim for flush mount applications as required to suit.
- .7 Install series rating lamicoids adjacent to all breakers utilized to achieve series ratings.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Electrical General Requirements Section.

**Part 2 Products**

**2.1 BREAKERS GENERAL**

- .1 Moulded case circuit breakers must conform to CSA C22.1 No.5.1-M91 (latest edition.)
- .2 Bolt-on moulded case circuit breaker quick-make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Unless otherwise indicated moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .5 Moulded case circuit breakers 250 Amps and above are to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase and ground fault short circuit protection (if indicated or applicable by the Electrical Safety Code versus the breaker amperage). Unless otherwise specified, complete system selective co-ordination shall be provided by the individually adjustable time/current curve shaping elements as following:
  - .1 Breakers shall have fixed rating plug determining breaker continuous current rating.
  - .2 All breakers shall have adjustable long delay pickup and time, L.
  - .3 All breakers shall have individual adjustments for short delay pickup and time, S; including I2t settings in time adjustment.
  - .4 Breakers shall have adjustable instantaneous pickup, I; that if required by co-ordination study can be turned off, (I).
  - .5 If required by Electrical Safety Code breakers shall have individually adjustable ground fault current pick-up and time, G; including I2t settings in time adjustment.
  - .6 Unless otherwise specified, for the low voltage systems provide an electronic trip unit as specified above for the following moulded case circuit breakers:
    - .1 Mains or ties in main switchboard: LS trip unit with fixed instantaneous over-ride exceeding maximum value of fault at the point of installation.



**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install circuit breakers as indicated complete with all necessary mounting hardware and filler panels if necessary.
- .2        Provide lamicoid labels for series rating breakers. Lamicoid label to state "Series Rating Breaker." Lamicoid to be size 2.

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Electrical General Requirements Section.

**Part 2 Products**

**2.1 SWITCHES**

- .1 Line Voltage Wall Switches
  - .1 AC switches must conform to CSA C22.2 No. 111 (latest edition).
  - .2 AC switches with following features:
    - .1 Terminal holes approved for No. 10 AWG wire.
    - .2 Silver alloy contacts.
    - .3 Urea or melamine molding for parts subject to carbon tracking.
    - .4 Suitable for back and side wiring.
    - .5 Toggle style (Rocker style) (architect to select colour).
  - .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
  - .4 AC Switches of one manufacturer throughout project.
  - .5 Provide 2 keys per keyed switch.
  - .6 Occupancy sensor switches shall be dual technology style (PIR and Ultrasonic) where noted on the drawings.
  - .7 Acceptable Materials:
    - .1 Single Pole : Hubbell Cat #HBL1201
    - .2 Motor Rated: Hubbell Cat. #HBL1221PL
    - .3 Single Relay Occupancy Sensor includes:
      - .1 Legrand Cat. #DW-100
      - .2 Greengate Cat. #ONW-D-1001
      - .3 Sensorswitch Cat. #WSXA Series
    - .4 Dual Relay Occupancy Sensor includes:
      - .1 Legrand Cat. #DW-200
      - .2 Greengate Cat. #ONW/VNW-D-1001-DMV-N
      - .3 Sensorswitch Cat. #WSXA Series
  - .8 Acceptable toggle switch alternate manufacturers include:
    - .1 Pass & Seymour
    - .2 Leviton.

- .2 Line Voltage 0-10V Dimming Switches
  - .1 0-10V Dimmers are to be provided complete with the following features:
    - .1 Rating of 15A or 20A, 120V or 347V.
    - .2 0-10V dimming leads
    - .3 Capable of operation with four switch locations.
    - .4 DIP switches or local programming through switch buttons to change mode of operation.
    - .5 Integral on/off switch.
    - .6 Devices must mount in single gang box or multi-ganged where noted.
    - .7 Device and faceplate colour must match other wiring devices.
    - .8 Integral dual technology occupancy sensors (PIR and Ultrasonic).
  - .2 Acceptable Materials:
    - .1 0-10V Occupancy Wall Sensor Switch (Decora): Legrand Cat. #DW-311
    - .2 0-10V Dimming Switch: Leviton Cat. #ZS057 Series
  - .3 Acceptable alternative manufacturer's include:
    - .1 Legrand
    - .2 Leviton
    - .3 Lutron
    - .4 Sensor Switch
    - .5 Greengate
- .3 Digital Interval Timer Switches
  - .1 Where noted supply and install a digital pre-set countdown time switch with the following features:
    - .1 minimum 1/6 HP rated contacts, mounted in recess single gang outlet box.
    - .2 Six (6) pre-set time selection buttons with options up to 1 hour.
    - .3 Unit shall be complete with activation indicator lights.
    - .4 Unit shall have integral On/Off button.
    - .5 White finish unless noted otherwise. (final finish selection by Architect).
  - .2 Acceptable Materials:
    - .1 Legrand Cat. #RT-50
  - .3 Acceptable alternative manufacturer's include:
    - .1 Leviton
    - .2 Lutron
    - .3 Hubbell

## **2.2 RECEPTACLES**

- .1 Receptacles, plugs, and other similar wiring devices must conform to CSA 22.2 No 42 (latest edition).
- .2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features (20A where noted):
  - .1 Urea molded housing (Colour by architect).
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and rivetted grounding contacts.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Acceptable materials:
  - .1 Above 20A
    - .1 Dryer receptacle: Hubbell Cat # HBL9430A
    - .2 Range receptacle: Hubbell Cat # HBL9450A
  - .2 Decora Style Devices
    - .1 Ground fault protected T-slot receptacles: Hubbell Cat. # GF20L A
    - .2 USB charger duplex receptacles: Hubbell Cat. # USB15X2 XX
    - .3 USB charger T-slot receptacles: Hubbell Cat. #USB20X2 XX
    - .4 Decora style duplex receptacle: Hubbell Cat. # HBL2152
    - .5 Decora T-slot receptacle: Hubbell Cat. # HBL2162
- .6 Acceptable alternate manufacturers include:
  - .1 Pass & Seymour
  - .2 Leviton

## **2.3 COVER PLATES**

- .1 Cover plates from one manufacturer throughout project.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, brushed, 1 mm (1/32") thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof cover plates complete with gaskets and "heavy-duty in use" covers in conformance with the Electrical Safety Authority. Provide product equal to Intermatic Cat. #WP5100C.

- .6 Provide p-touch labels on cover plates for all receptacles. Labels shall include source panel and branch circuit, including switch leg indicator as applicable for automatically controlled receptacles.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height specified in Electrical General Requirements Section or as indicated.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height specified in Electrical General Requirements Section or as indicated.
- .3 Occupancy sensors:
  - .1 Occupancy sensors shall be set to 5 minutes "delay to off" unless otherwise noted.
- .4 Occupancy sensors and dimmers:
  - .1 Switches with occupancy sensors and dimmers shall be programmed as follows:
    - .1 5 minutes "delay to off" unless otherwise noted.
    - .2 "Auto on" to 50% dimming level.
- .5 Cover plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .6 Dimmer:
  - .1 Dimming Switches
    - .1 Mount devices at height as specified in Electrical General Requirements Section.
    - .2 Install in upright position as per manufacturer's installation instructions.
    - .3 Provide class II 0-10V control wiring from 0-10V dimming switch to each fixture driver in 21mmC.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA C22.2 No.248.12/94, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).
  - .2 CSA C22.2 No. 106-M92 (latest edition).

**1.2 MAINTENANCE MATERIAL**

- .1 Three spare fuses of each type and size installed.

**1.3 DELIVERY AND STORAGE**

- .1 Ship fuses in original containers.
- .2 Store fuses in original containers in moisture free location.

**Part 2 Products**

**2.1 FUSES GENERAL**

- .1 Fuses: product of one manufacturer for entire project.
- .2 Fuses specified below must conform to CSA C22.2 No. 106 (latest edition). Fuses conforming to standard C22.2 No. 106-1953 will be rejected.
- .3 Fuses must provide a fully co-ordinated system for both overload and fault conditions.

**2.2 FUSE TYPES**

- .1 Class L fuses (formerly HRC-L ) for ratings 601-6000 A.
  - .1 Time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Fast acting as noted.
- .2 Class J fuses (formerly HRCI- J).
  - .1 Time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Fast acting as noted.
- .3 Class R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and  $I^2t$  values not to exceed limits of UL 198E-1982, table 10.2.

**2.3 ACCEPTABLE PRODUCTS**

- .1 Motor Protection:
  - 1-600 A: Mersen Type AJT
  - 601-2000 A: Mersen Type A4BT

- .2 Other acceptable manufacturers:
  - .1 GEC
  - .2 Little Fuse

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
  - .1 Install Class R rejection clips for HRCI-R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Electrical General Requirements Section.

**Part 2 Products**

**2.1 DISCONNECT SWITCHES**

- .1 Enclosed manual air break switches must conform to CSA C22.1 No.4 (latest edition).
- .2 Fuseholder assemblies must conform to CSA C22.2 No.39 (latest edition).
- .3 Fusible, and/or non-fusible, horsepower rated disconnect switches, size as indicated.
- .4 Provision for padlocking in off switch position by three locks.
- .5 Mechanically interlocked door to prevent opening when handle in ON position.
- .6 Fuses: size as indicated, to Fuses - Low Voltage Section.
- .7 Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.
- .8 Quick-make, quick-break action.
- .9 ON-OFF switch position indication on switch enclosure cover.

**2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Indicate name of load controlled on size 4 nameplate.

**2.3 ACCEPTABLE MANUFACTURERS**

<u>Manufacturer</u>	<u>General Purpose</u>	<u>Weather Proof</u>
Eaton	IHD Series	3HD Series
Schneider Electric	Type A Series	Type R Series
Siemens	ID Series	NFR/FR Series

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

**END OF SECTION**



**Part 1 General**

**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Electrical General Requirements Section.
- .2 Indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter/contacter size and type.
  - .3 Layout of identified internal and front panel components.
  - .4 Enclosure types.
  - .5 Wiring diagram for each type of starter.
  - .6 Interconnection diagrams.

**1.2 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into manual specified in Electrical General Requirements Section.
- .2 Include operation and maintenance data for each type and style of starter/contacter.

**1.3 MAINTENANCE MATERIALS**

- .1 Provide maintenance materials in accordance with Electrical General Requirements Section.
- .2 Provide listed spare parts for each different size and type of starter:
  - .1 1 operating coil.
  - .2 3 fuses.
  - .3 10% indicating lamp bulbs used.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Starters: must conform to CSAC22.2 No. 14 (latest edition) and EEMAC E14-1.
- .2 Control transformers must conform to CSAC22.2 No. 66 (latest edition).
- .3 Auto-transformers must conform to CSAC22.2 No 47 (latest edition).
- .4 Contactors must conform to CSA C22.2 No. 14 (latest edition).
- .5 Half size starters will not be accepted. NEMA and IEC rated starters are acceptable.

**2.2 MANUAL MOTOR STARTERS**

- .1 Single and Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.

- .2 One or Three overload heaters, manual reset, trip indicating handle.
- .3 Toggle switch: standard duty labeled "on"/"off".
- .4 Indicating light: standard duty type and red colour.
- .5 Locking tab to permit padlocking in "ON" or "OFF" position.

## **2.3 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
  - .1 Locking in "OFF" position with up to 3 padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Pushbuttons Selector switches standard duty labeled as indicated.
  - .2 Indicating lights: standard duty type and color as indicated.
  - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.
  - .4 1 red pilot light for "stop" or "off" and 1 green light for "start" or "on".

## **2.4 CONTROL TRANSFORMER**

- .1 Single phase, dry type, control transformer with primary voltage as indicated and secondary voltage to suit remote control device, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## **2.5 CONTACTORS**

- .1 Electrically held and controlled by pilot devices as indicated and rated for type of load controlled.
- .2 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .3 Mount in CSA Enclosure 1 unless otherwise indicated.
- .4 Include following options in cover:
  - .1 Red indicating lamp.
  - .2 Hand - Off - Auto selector switch.

- .5 Control transformer: mounted in contactor enclosure.
- .6 Contactors must be definite purpose.

## **2.6 FINISHES**

- .1 Apply finishes to enclosure in accordance with Electrical General Requirements Section.

## **2.7 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Manual starter designation label: black plate, white letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label: black plate, white letters, size 2, engraved as indicated.
- .4 Contactor designation label:  
black plate, white letters, size 4, indicating name of load controlled.

## **2.8 ACCEPTABLE MANUFACTURERS**

- .1 The acceptable manufacturers are as follows:
  - .1 Allen Bradley
  - .2 Eaton
  - .3 Siemens
  - .4 Group Schneider
  - .5 Klockner Moeller

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Electrical General Requirements Section.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5 Install contactors and connect auxiliary control devices.

**END OF SECTION**

**Part 1 General**

**1.1 CODES AND STANDARDS**

- .1 The generator set and its installation and on-site testing shall conform to the requirements of the following codes and standards:
  - .1 Latest edition of the Electrical Safety Code.
  - .2 CSA C22.2, No. 14 – (latest edition) Industrial Control Equipment.
  - .3 CSA C282, (latest edition) Emergency Electrical Power Supply for Buildings
  - .4 IEC8528 part 4. Control Systems for Generator Sets
  - .5 NEMA ICS10-1993 – AC Generator sets.
  - .6 UL508. The entire control system of the generator set shall be UL508 listed and labeled.
  - .7 UL2200. The genset shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.
  - .8 EPA Tier 1 engine requirements for Emergency Standby Power.
  - .9 O. Reg. 245/11 – EASR Standby Power Systems.

**1.2 DESCRIPTION OF SYSTEM**

- .1 Generating system consisting of factory assembled generator set equipment with digital electronic controls.
- .2 The system components shall consist of:
  - .1 Natural gas engine.
  - .2 Alternator.
  - .3 Alternator control panel.
  - .4 Battery charger and battery.
  - .5 Fuel supply system.
  - .6 Exhaust system.
  - .7 Steel mounting base.
  - .8 Remote annunciator.
  - .9 Skin-tight weather-protective C282 compliant enclosure complete with accessories power panel, emergency battery unit, heater, maintenance receptacle, silencer, and motorized dampers as required.
  - .10 Mainline output and Load bank testing breakers.
  - .11 Spill containment for engine oil and coolant per NFPA 37.
  - .12 Generator exhaust Selective Catalytic Reduction (SCR) system as required to comply with EPA NOx emissions requirements and O. Reg. 245/11.

### **1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Electrical Contract General Requirements Section.
- .2 Include the following in the shop drawing submitted:
  - .1 Engine: make and model, with performance curves.
  - .2 Alternator: make and model.
  - .3 Voltage regulator: make, model and type.
  - .4 Battery: make, type and capacity.
  - .5 Battery charger: make, type and model.
  - .6 Alternator control panel: make and type of meters and controls.
  - .7 Governor type and model.
  - .8 Cooling air requirements.
  - .9 Combustion air requirements
  - .10 British standard or DIN rating of engine.
  - .11 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, walk-in enclosure, and total weight.
  - .12 Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.
  - .13 Manufacturer's certification of prototype testing.
  - .14 Manufacturer's published warranty documents.
  - .15 Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
  - .16 Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
  - .17 Selective Catalytic Reduction (SCR) system details including mounting and total weight, DEF capacity, etc.
  - .18 Fuel consumption in scfh at 100% load
  - .19 Manufacturer's installation instructions.

### **1.4 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for generator for incorporation into project maintenance manual as specified in the Electrical Contract General Requirements Section.
- .2 Include in Operation and Maintenance Manual instructions for specific unit supplied and not general description of units manufactured by supplier and:
  - .1 Operation and maintenance instructions for engine, alternator, control panel, battery charger, battery, fuel system, exhaust system and accessories, to permit effective operation, maintenance and repair.

- .2 Technical data:
  - .1 Illustrated parts lists with parts catalogue numbers.
  - .2 Detailed dimensions of unit.
  - .3 Schematic diagram of electrical controls.
  - .4 Flow diagrams for:
    - .1 Fuel system.
    - .2 Lubricating oil.
  - .5 Cooling system cfm airflow for 104°F (40°C) ambient max.
  - .6 Combustion system cfm airflow.
  - .7 Fuel consumption in scfh.
  - .8 Certified copy of factory test results.
  - .9 Prime or standby rating.
  - .10 Spill containment system for engine oil and coolant.
  - .11 Single or multiple venting connections to match basis of design. **Must match venting connections provisions per mechanical design drawings.**
  - .12 Maintenance and overhaul instructions and schedules.
  - .13 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

## 1.5 MAINTENANCE MATERIALS

- .1 Include:
  - .1 2 fuel filter replacement elements.
  - .2 2 lube oil filter replacement elements.
  - .3 2 air cleaner filter elements.
  - .4 2 sets of fuses for control panel.
  - .5 Special tools for unit servicing.

## 1.6 SOURCE QUALITY CONTROL

- .1 Factory testing:
  - .1 The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.
  - .2 Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns. Factory tests shall be included for a minimum of 1 hour time.

- .2 Site test procedure:
  - .1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:
    - .1 Date.
    - .2 Generator set serial no.
    - .3 Engine, make, model, serial no.
    - .4 Alternator, make, model, serial no.
    - .5 Voltage regulator, make and model.
    - .6 Rating of generator set, kW, kVA, V, A, r/min, Hz.
  - .2 Mark check sheet and record data on forms in duplicate as test proceeds.
  - .3 Provide testing technician's signature on completed forms to indicate concurrence in results of test and submit to consultant.
  - .4 All testing to be in accordance with Section 10 Initial Installation Performance Tests in CSA C282-19.

## **1.7 WARRANTY**

- .1 The generator set manufacturer shall warrant all equipment provided under this section, whether or not manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.
- .2 Provide a written guarantee from the date of substantial completion, signed and issued in the name of the owner, stating that the generating set is guaranteed against defects in material and workmanship for a period of 5 years or 1500 operating hours, whichever comes first for the generator set.
- .3 The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Basis of Design Manufacturer:
  - .1 Generac. Model # per Generator Schedule on design drawings.
- .2 Approved Alternate Manufacturers:
  - .1 Paramount Power Systems
  - .2 Toromont Power Systems
  - .3 Cummins

- .3 Alternate manufacturers must advise consultant in writing 1 week prior to bid closing of any differences from the basis of design set characteristics including, but not limited to, engine size and footprint. Failure to advise of such differences does not alleviate the bidding trade and manufacturer responsibilities for costs associated with the resulting installation and performance changes to the project. Comply with the Alternates and Substitutions requirements of Electrical Contract General Requirements Section.

## **2.2 GENERATOR SET**

- .1 Ratings
  - .1 The generator set shall operate at 1800 rpm and at a voltage of: 347/600 Volts AC, Three phase, Four-wire, 60 hertz.
  - .2 The generator set shall have 100 kW(kVA) rating at 0.8 PF, standby or prime rating, based on site conditions of 1000 ft. (300 meters) altitude, ambient temperatures up to **104°F (40°C)**, per Generator Schedule.
- .2 Construction
  - .1 The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails
  - .2 All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.
- .3 Connections
  - .1 The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
  - .2 Power connections to auxiliary devices shall be made at the devices, with required protection located at a local branch circuit panel.
  - .3 Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.
  - .4 The generator set shall be provided with a mounted main line electronic LSI style circuit breaker, sized to carry the rated output current of the generator set on a continuous basis. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided. The breaker must have a minimum interrupting rating as indicated on design drawings.
  - .5 The generator set shall be provided with a mounted load bank test circuit breaker, sized to carry the rated output current of the generator set to facilitate full load testing per the requirements of CSA C282.



## **2.3 ENGINE AND ENGINE EQUIPMENT**

- .1 The engine shall be natural gas, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:
  - .1 An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.
  - .2 Skid mounted radiator and cooling system rated for full load operation in 104°F (40°C) ambient as measured at the generator air inlet, based on 0.5 in H<sub>2</sub>O external static head. Radiator shall be sized based on a core temperature which is 20°F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with a 50/50-ethylene glycol/water mixture by the equipment manufacturer. Rotating parts shall be guarded against accidental contact.
  - .3 Electric starter(s) capable of three complete cranking cycles without overheating.
  - .4 Positive displacement, mechanical, full pressure, lubrication oil pump.
  - .5 Full flow lubrication oil filters with replaceable spin on canister elements and dipstick oil level indicator.
  - .6 Fuel filter with replaceable spin on canister element.
  - .7 Replaceable dry element air cleaner with restriction indicator.
  - .8 Flexible supply and return fuel lines.
  - .9 Engine mounted battery charging alternator, 40-ampere minimum, and solid state voltage regulator.
  - .10 Coolant heater with the following features:
    - .1 Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
    - .2 The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches.
    - .3 The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100°F (40°C) in a 40°F ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

- .11 Provide vibration isolators, spring type, quantity as recommended by the generator set manufacturer.
- .12 Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors.
- .13 Provide exhaust silencer of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall as a minimum be critical grade. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards. The silencer shall be provided complete with drain, plug, and flanged couplings. A heavy duty flexible exhaust pipe with flanged couplings is to be provided from the generator set. Unless noted otherwise, silencers are to be factory installed.
- .14 A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for the engine generator set. The charger is to be mounted within enclosure unless noted otherwise on the drawings. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:
  - .1 Loss of AC power red light
  - .2 Low battery voltage red light
  - .3 High battery voltage red light
  - .4 Power ON green light (no relay contact)Note: Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses.

## **2.4 GENERATOR SET CONTROL**

- .1 The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set and remote monitoring.
- .2 The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

## **2.5 OUTDOOR WEATHER-PROTECTIVE SOUND ATTENUATING SKIN-TIGHT ENCLOSURE**

- .1 The generator set shall be provided with a weather-protective, sound-attenuated C282 compliant skin-tight enclosure which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 70 dBA for units 150kW or less and 75 dBA otherwise, at any location 7 metres from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant.

- .2 The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a raincap and rainshield.
- .3 Within the generator enclosure, the generator supplier is to provide a panel that will feed the generator battery charger and block heater as well as the enclosure normal lighting, and space heater designed to maintain the enclosure at 40°F. All of these components are to be supplied, installed, and connected in the factory. The panel is to be CSA approved and bear the stamp of the Electrical Safety Authority.

## **2.6 FUEL SYSTEM**

- .1 Fuel system shall be pipeline grade natural gas.

## **2.7 COOLING AIR SYSTEM**

- .1 Unless noted otherwise, the engine ventilating system will be factory supplied and installed.

## **2.8 FINISHES**

- .1 Unless specified otherwise the generator set finish shall be the manufacturer's standard colour.
- .2 Supply 1 can of touch-up enamel.

## **2.9 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Electrical Contract General Requirements Section.
- .2 Control panel:
  - .1 Size 4 nameplates for controls such as alternator breakers and program selector switch.
  - .2 Size 2 nameplates for meters, alarms, indicating lights and minor controls.

## **Part 3 Execution**

### **3.1 SEQUENCE OF OPERATION**

- .1 Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control and a redundant signal over the required network connection.
- .2 The generator set shall complete a time delay start period as programmed into the control.

- .3 The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:
  - .1 The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set and indicate “fail to crank” shutdown.
  - .2 The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out and the control system shall indicate “fail to start”.
  - .3 The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.
- .4 On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.
- .5 When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.
- .6 On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.
  - .1 Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.
- .7 Demonstrate:
  - .1 Automatic starting of set and automatic transfer of load on failure of normal power.
  - .2 Automatic shut down of engine on resumption of normal power.
  - .3 That battery charger reverts to high rate charge after cranking.
- .8 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

### **3.2 INSTALLATION**

- .1 Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable provincial and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

- .2 Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections under the supervision of the equipment supplier.
- .3 Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and requirements of the site.
- .4 Equipment shall be initially started and operated by representatives of the manufacturer.
- .5 All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

### **3.3 FIELD QUALITY CONTROL**

- .1 On site acceptance test.
  - .1 The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer. The consultant shall be notified a minimum of 7 days in advance and shall have the option to witness the tests.
  - .2 Installation acceptance tests to be conducted on site shall include a "cold start" test for 1 hour accordance with CSA C282 (latest edition).
  - .3 Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system. Coordinate timing and obtain approval for start of test with site personnel.
  - .4 In conformance with CAN-CSA C282 the supplier is to perform an on-site load test for:
    - .1 1 hour at building load for the Operational Test.
    - .2 4 hours at 100% load for the Site Design Load Test.
  - .5 Submit test results for review and include in maintenance manual.
  - .6 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

### **3.4 COMMISSIONING**

- .1 Manufacturer to:
  - .1 Certify installation.
  - .2 **Start up, commission installation.**
  - .3 Carry out on-site performance verification tests.
  - .4 Demonstrate operation and maintenance.
- .2 Provide consultant at least 48 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

**3.5 TSSA INSPECTION**

- .1 This contractor shall make application, arrange, and pay for a TSSA inspection of the generator and associated equipment installed under the contract at the completion of the project and prior to final acceptance of the system.
- .2 Provide a copy of the TSSA report in the maintenance manuals.

**3.6 TRAINING**

- .1 The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 2 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

**3.7 SERVICE AND SUPPORT**

- .1 The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.
- .2 The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- .3 The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

**3.8 INTEGRATED LIFE SAFETY SYSTEM TESTING**

- .1 This electrical contractor shall participate in “Integrated Testing” of the emergency generator life safety system in conformance with the noted specification section and Electrical Contract General Requirements. Include all associated costs in tender.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Electrical General Requirements Section.

**1.2 SCOPE**

- .1 Furnish and install the low voltage automatic transfer switches having the ratings, features/accessories and enclosures as specified herein and as shown on the contract drawings.

**1.3 REFERENCES**

- .1 The automatic transfer switches and bypass isolation automatic transfer switches shall be designed, manufactured and tested in accordance with the latest applicable standards as follows:
  - .1 UL 1008: Standard for Safety - Transfer Switch Equipment
  - .2 CSA C22.2 No. 178.1: Automatic Transfer Switches
  - .3 Canadian Electrical Code C22.1-21 or Ontario Electrical Safety Code, latest edition.

**1.4 SUBMITTALS**

- .1 The following information shall be submitted to the Engineer:
  - .1 Front view and plan view of the assembly.
  - .2 Schematic diagram.
  - .3 Conduit space locations within the assembly.
  - .4 Assembly ratings including:
    - .1 Voltage rating.
    - .2 Continuous current rating.
    - .3 Withstand and closing ratings.
  - .5 Cable terminal sizes.
  - .6 Product data sheets.
  - .7 Connection details between close-coupled assemblies.
  - .8 Composite front view and plan view of close-coupled assemblies.

**1.5 QUALIFICATIONS**

- .1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- .2 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

**1.6 REGULATORY REQUIREMENTS**

- .1 Provide a UL1008 certificate of compliance for the transfer switches furnished under this section.

**1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Equipment shall be handled and stored in accordance with manufacturer's instructions.
- .2 One (1) copy of these instructions shall be included with the equipment at time of shipment.
- .3 Equipment being stored prior to installation shall be maintained in a clean and dry condition. If stored outdoors, indoor equipment shall be covered and heated, and outdoor equipment shall be heated.

**1.8 OPERATION AND MAINTENANCE MANUALS**

- .1 Comply with all requirements of specification section 26 01 16 Electrical Contract General Requirements.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Generac (Basis of Design)
- .2 Paramount (Kohler)
- .3 Asco
- .4 Cummins
- .5 Products from manufacturers by others not listed will NOT be accepted for this bid.

**2.2 CONSTRUCTION**

- .1 Transfer switches shall be UL 1008 listed for application in their intended enclosures at 100% of continuous ampere rating and shall meet or exceed UL 1008 endurance test criteria to include rate of operation and number of operation cycles.
  - .1 The transfer switch shall be designed and intended for switching the load connection between two power sources.
  - .2 The transfer switch shall include electrical and mechanical interlocks to prevent unintentional paralleling of the power sources.
  - .3 The transfer switch shall be of double throw construction and the electrical operator shall be a reliable solenoid mechanism, momentarily energized.
  - .4 There shall be a direct mechanical coupling to facilitate completion of an open in-phase transition such that any inrush current is equal to or less than normal starting current for inductive loads.



- .5 The transfer switch main contacts shall be of silver composition, electrically operated and mechanically held in position. Inspection of the main contacts shall be possible from the front of the transfer switch without major disassembly.
- .6 The transfer switch shall include removable arc chutes, housed within an arc chamber constructed of high-dielectric high-strength material, that are mounted over each set of main contacts. Arc chutes shall be constructed of metal plates and a baffle cover designed to extinguish an electrical arc and protect the main contacts.
- .7 The transfer switch shall include colored, mechanical position indication of the main contacts for source 1 and source 2.
- .8 The transfer switch will be supplied with a handle for manual operation and shall only be performed with the transfer switch de-energized to allow exercising the main contacts through their full range of motion for inspection.
- .2 Transfer switches shall be open transition and provide an in-phase monitor that will permit a transfer or re-transfer between two live sources that have a phase angle difference of +/- 8 degrees or less.
- .3 The transfer switch shall include a means of deriving control power for electrical operation. Control power transformers shall be multi-tap for ease of voltage adjustment in the field. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.
- .4 Transfer switches requiring a solid neutral shall include a fully rated, solid neutral plate.

## **2.3 ENCLOSURE**

- .1 Each transfer switch shall be provided in a NEMA 3R enclosure suitable for use in environments indicated in the drawings.

## **2.4 WITHSTAND AND CLOSING RATING**

- .1 The transfer switch shall be UL1008 listed and rated for use in a circuit capable of delivering the short-circuit current shown on the contract drawings.
- .2 The transfer switch shall have a short-circuit withstand as shown on drawings.

## **Part 3 Execution**

### **3.1 FACTORY TESTING**

- .1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
  - .1 Insulation check to ensure the integrity of insulation and continuity of the entire system.
  - .2 Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards.

- .3 Mechanical tests to verify that the switch's power sections are free of mechanical hindrances.
- .4 Electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic.
- .2 The manufacturer shall provide a certified copy of factory test reports.
- .3 Transfer switch shall include a label indicating order number, catalog number and date.

### **3.2 INSTALLATION**

- .1 The contractor shall install all equipment per the manufacturer's recommendations and in accordance with the contract drawings
- .2 All necessary hardware to secure the assembly in place shall be provided by the contractor.

### **3.3 START-UP AND COMMISSIONING**

- .1 The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor.
- .2 Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system. Coordinate timing and obtain approval for start of test with site personnel.
- .3 Submit test results for review and include in maintenance manual.
- .4 Testing to be performed in conjunction with the requirements of specification section 26 32 16 Power Generation Natural Gas Outdoor.

### **3.4 FIELD QUALITY CONTROL**

- .1 Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of 3 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

### **3.5 MANUFACTURER'S CERTIFICATION**

- .1 A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- .2 The contractor shall provide a copy of the manufacturer's representative's certification.

### **3.6 TRAINING**

- .1 The contractor shall conduct a training session for up to five (5) owner's representatives for 3 normal workdays at a jobsite location determined by the owner. The training program shall consist of the instruction on the operation of the transfer switch and the major components within the assembly.

**3.7 FIELD SERVICE ORGANIZATION**

- .1 The manufacturer of the ATS shall also have a national service organization that is available throughout Canada and is available on call 24 hours a day, 365 days a year.

**3.8 INTEGRATED LIFE SAFETY SYSTEM TESTING**

- .1 This electrical contractor shall participate in integrated testing of this life safety system in conformance with Electrical General Requirements. Include all associated costs in tender.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 The specifications in this section describe the electrical and mechanical requirements for a protection system provided by high-energy transient voltage surge suppressors. The specified system shall provide effective, high-energy surge current diversion and be suitable for application in ANSI/IEEE C62.4.1.1 Category A, B and C environments (as tested by ANSI/IEEE C62).

**1.2 STANDARDS**

- .1 The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:
  - .1 Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41, C62.45)
  - .2 American National Standards Institute
  - .3 National Electrical Manufacturer Association (NEMA LS-1 1992 Peak Current Testing)
  - .4 Electrical and Electronic Mfg. Association of Canada (EEMAC)
  - .5 National Fire Protection Association (NFPA 75 and 780)
  - .6 MIL Standard 220A Method of Insertion Loss Measurement
  - .7 Ontario Electrical Code
  - .8 Underwriters Laboratories UL 1283 and UL 1449 (latest edition)
  - .9 Canadian Standards (CUL)

**1.3 ENVIRONMENTAL REQUIREMENTS**

- .1 The operating temperature range shall be -40° to 70° C (-40° to 160° F).
- .2 No appreciable magnetic fields shall be generated.

**1.4 SUBMITTALS**

- .1 Product Data: Provide catalog sheets showing voltage, physical size, IEEE let through 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.
- .2 Submit product data for all components and accessories per section 26 01 16 'Electrical General Requirements'.

- .3 Manufacturer's Installation Instructions: Indicate application conditions and limitations of 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.
- .4 List and detail all protection systems such as fuses, disconnecting means and protective features.
- .5 Provide verification that the SPD device complies with the required UL1449 latest edition, latest revision, and CSA approvals.
- .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 ANSI/IEEE C62.45.
- .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 40 dB at 100 kHz.
- .8 Provide test report from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on a per mode 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.

#### **1.5 QUALITY ASSURANCE AND WARRANTY**

- .1 The panel mounted SPD and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for a period of thirty (30) years from the date of substantial completion of service and activation of the system to which the suppressor is attached. Additionally, during the applicable warranty period, any SPD which fails due to any electrical anomaly, including lightning, shall be repaired or replaced by the manufacturer without charge. Special or optional warranties in excess of the unit's standard warranty for purposes of this bid are not acceptable.
- .2 The warranty must specifically provide for unlimited free replacements of the SPD in the event of failure caused by the effects of lightning and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only. Special warranties for the purpose of this bid are not allowed.
- .3 If the SPD units supplied do not meet the specifications as written, contractor will remove units and re-install approved SPD units to the satisfaction of the consultant. Contractor will be responsible for any and all costs associated with re-installation.

## **Part 2 Products**

### **2.1 PERFORMANCE**

- .1 The SPD shall be listed by ETL, UL, or other nationally recognized test laboratory to UL's 1283 and UL's 1449 standards (latest edition), and not merely the components or modules. All SPD's shall be Type 1 for use in Type 1 and Type 2 locations.
- .2 The SPD shall protect all modes L-G, L-N, L-L, and N-G, have discrete suppression circuitry in L-G, L-N and N-G, and have bidirectional, positive and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified and accordingly reduced mode units with suppression circuitry built into only 4 modes are not acceptable. In delta systems, line-to-ground-to-line protection is not acceptable where line-to-line is specified.
- .3 Obtain all surge suppression devices through one source from a single manufacturer.
- .4 The maximum continuous operating voltage (MCOV) of all components shall not be less than 125% for a 120V system and 120% for 208 systems, and 115% for 347 and 600V systems.
- .5 All SPD's shall be equipped with a comprehensive monitoring system which shall include a visual LCD panel display providing information on unit status and phase loss/protection loss.
- .6 Each design configuration shall have the maximum single pulse surge current capacity per mode verified through testing at an independent, nationally recognized test laboratory. The manufacturer must submit a test report on a unit which was tested with internal over current fusing in place. The test shall include a UL1449 Second Edition surge defined as a 1.2 X 50  $\mu$ sec 6000V open circuit voltage waveform and an 8 X 20  $\mu$ sec 500A short circuit current waveform to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current magnitude with an approximated 8 X 20  $\mu$ sec waveform. To complete the test, another UL1449 surge shall be applied to verify the unit's survival. Compliance is achieved if the suppression voltage found from the two UL1449 surges does not vary by more than +10%. Test data on an individual module is not acceptable.
- .7 SPD manufacturer shall be Total Protection Solutions Canada, as provided by Innosys Power Inc. and represented by Medgar LCI (Contact Scott McGregor, Ph: 519-500-7120).

### **2.2 SERVICE ENTRANCE PROTECTION**

- .1 The SPD for this location shall be as indicated on project drawings. SPD shall be separate from panelboard. Integral SPD shall not be acceptable. SPD's shall be certified to UL1283 and UL 1449 (latest edition). Type 1 for use in Type 1 or Type 2 locations. All SPD units shall be RoHS compliant.  
Medium to Low Exposure: Up to 1200 amps Service entrance panels shall be protected by a 240Ka Total Protection Solutions) panel mounted SPD, model TK-ST240-3Y600-L for 347/600 wye (4W+G) volt panels and model TK-ST240-3Y208-L for 120/208 wye (4W+G) volt panels.

- .2 The manufacturer shall provide written specifications showing let-through voltage of the unit with six inches of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41 and C62.45, 2002, categories C1 and C3 bi-wave, 90 degree phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic tests except N-G, and UL suppressed voltage ratings, all of which shall be no higher than:

ANSI/IEEE C62.41-1991 Measured Limiting Voltage

B3/C1 Impulse (6kV, 3kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	502V	627V	864V	568V
347/600 (3Y600)	1090V	1144V	2017V	1155V

C3 Impulse (20kV, 10kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	907V	1173V	1267V	1090V
347/600 (3Y600)	1537V	1707V	2470V	1800V

UL Voltage Protection Ratings

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	800V	800V	1200V	800V
347/600 (3Y600)	1500V	1500V	2500V	1500V

- .3 The unit shall have a peak surge current of no less than 200kA/mode, 8 X 20 us waveform, single impulse, independently verified.
- .4 Internal Fusing - Over current Protection
- .1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Over current fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode over current fusing is not acceptable where there is more than one MOV per mode.
- .2 For arc quenching capability, minimization of smoke and contaminants in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.
- .3 Fusing shall be present in every mode, including Neutral-to-Ground.
- .4 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.
- .5 The suppressor shall include Form C dry contacts (N.O. or N.C.) for remote monitoring capability, and shall have at minimum a EEMAC 2 steel enclosure.
- .6 The SPD shall have an internal audible alarm with mute on front cover.
- .7 SPD's for service entrance locations shall have a transient event counter with LCD panel display and reset button on the front cover.

- .8 When SPD lead lengths exceed four (4) feet, low impedance cable (LIC) supplied by the SPD manufacturer shall be utilized. LIC shall have effective lead impedance min. 75% less than standard cable, and shall have nominal impedance, capacitance and inductance values that do not exceed the following:

Nominal Impedance (@10kHz, ohms/ft) Nominal Capacitance  
 (pf/ft) Nominal Inductance

(μH/ft)

Line	0.009	35.6	0.098
Neutral	0.004	52.6	0.041
Ground	0.004	571	0.021

SPDs shall be installed such that lead length is minimized.

## 2.3 DISTRIBUTION PANEL

- .1 SPD(s) for this location shall be as indicated on project drawings. SPD shall be separate from panel board. Integral SPD shall not be acceptable. SPD's shall be certified to UL 1283 and UL1449 (latest edition). Type 1 for use in Type 1 and Type 2 locations.
- .2 Distribution Panels shall be protected by a Total Protection Solutions panel mounted SPD, model TK-ST160-600NN-FL for 600 (3W+G) volt panels, model TK-ST160-3Y600-FL for 347/600 (4W+G) volt panels and model TK-ST160-3Y208-FL for 120/208 (4W+G) volt panels.
- .3 The manufacturer shall provide written specifications showing let-through voltage of the unit with six inches of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41 and C62.45, 2002, categories B3/C1 and C3 bi-wave, 90 degree phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic tests except N-G, and UL suppressed voltage ratings, all of which shall be no higher than:

ANSI/IEEE C62.41-1991 Measured Limiting Voltage

B3/C1 Impulse (6kV, 3kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	502V	627V	864V	568V
347/600 (3Y600)	1090V	1144V	2017V	1155V

C3 Impulse (20kV, 10kA)

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	907V	1173V	1267V	1090V
347/600 (3Y600)	1537V	1707V	2470V	1800V



UL Voltage Protection Ratings

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	800V	800V	1200V	800V
347/600 (3Y600)	1500V	1500V	2500V	1500V

- .4 The unit shall have a peak surge current of no less than 160kA/phase, 80kA/mode, 8 X 20 us waveform, single impulse, verified by third party test reports.
- .5 Internal Fusing - Over current Protection
  - .1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Over current fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode over current fusing is not acceptable where there is more than one MOV per mode.
  - .2 For arc quenching capability, minimization of smoke and contaminates in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.
  - .3 Fusing shall be present in every mode, including Neutral-to-Ground.
  - .4 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.
- .6 The suppressor shall include Form C dry contacts (N.O. or N.C.) for remote monitoring capability, and shall have at minimum a Nema 4 steel enclosure.
- .7 The SPD shall have an internal audible alarm with mute on front cover.

**2.4 SUBPANEL AND LIGHTING PANEL PROTECTION**

- .1 SPD(s) for this location shall be as indicated on project drawings. SPD shall be separate from panel board. Integral SPD shall not be acceptable. SPD's shall be certified to UL1283 and UL1449 (latest edition). Type 1 for use in Type 1 and Type 2 locations.
- .2 Subpanels and lighting panels shall be protected by a panel mounted SPD, TK-LP120-3Y208-L-F for 120/208 (4W+G) volt recessed panels and TK-TT2-065-3Y208-FL for surface mounted panels.

- .3 The manufacturer shall provide written specifications showing let-through voltage of the unit with six inches of lead length (at the module or at the lug data is not acceptable as it does not represent true "as installed" performance) pursuant to ANSI/IEEE C62.41 and C62.45, 2002, categories A1 & A3 ring wave, 180 degree phase angle, category B3 Ringwave, and UL suppressed voltage ratings, 90 degree phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic tests except N-G, which shall be no higher than:

ANSI/IEEE C62.41-1991 Measured Limiting Voltage

A1 Ring Wave (2kV, 67A) Tested at 180 degree phase angle

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	29V	46V	39V	40V

A3 Ring Wave (6kV, 200A) Tested at 180 degree phase angle

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	56V	61V	88V	112V

B3 Ring Wave (6kV, 500A) Tested at 90 degree phase angle

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	437V	592V	612V	324V

UL Voltage Protection Ratings

Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	700V	700V	1000V	700V

- .4 The unit shall have a peak surge current of no less than 120kA/phase, 60kA/mode, 8 X 20 us waveform, single impulse, verified by third party test reports.

- .5 Internal Fusing - Over current Protection

- .1 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Over current fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode over current fusing is not acceptable where there is more than one MOV per mode.
- .2 For arc quenching capability, minimization of smoke and contaminants in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.

- .3 Fusing shall be present in every mode, including Neutral-to-Ground.
- .4 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied.
- .6 The SPD shall be capable of attenuating internally generated ringing type transients and noise, and shall have an enhanced transient filter supported by a specification sheet which lists the IEEE A1 Ring Wave let-through levels no higher than those set forth above.
- .7 Due to space limitations, the enclosure shall not exceed 4.0" D x 4.0" W x 10.3" H to allow close-to-the load installation on flush mount panels and between adjacent panel board. For recessed panels, a flush mount cover plate shall be provided with each unit along with a flush mount accessory kit Cat. #LP-FMP.
- .8 The suppressor shall include Form C dry contacts (N.O. or N.C.) for remote monitoring capability, and shall have at minimum a Nema 1 steel enclosure.
- .9 The SPD shall have an internal audible alarm with mute on front cover.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install the SPDs with the conductors as short and straight as practically possible.
- .2 Follow the SPD manufacturer's recommended installation practice as outlined in the equipment installation manual. The electrical contractor shall ensure that all neutral conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated SPD.
- .3 Main service entrance units shall be installed on a 60 amp breaker that meets or exceeds the fault current rating of the switchgear.
- .4 Distribution, branch panel, and motor control center units shall be installed on 30 amp dedicated circuit breakers, or, where indicated, shall be wired directly to the main lugs or feed through lugs, or wired directly to the bus bars.
- .5 The installing contractor shall comply with all applicable codes.
- .6 SPD units shall be wired such that connection cable lead lengths are minimized. SPD manufacturer to advise installing contractor on required locations of low impedance cables (LICs).
- .7 **SPD manufacturer shall include in tender for pre-installation visit to the job site to confirm recommended installation methods. Indicate provision for this visit on shop drawing submission.**
- .8 **The entire SPD installation must be inspected by an authorized manufacturer's representative and supply certificate of completion. This cost shall be included in the tender price. Indicate provision for this inspection on shop drawing submission.**

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE C62.41- 1991, Recommended Practices for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM F1137- 88 (1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .3 United States of America, Federal Communications Commission (FCC)
  - .1 FCC (CFR47) EM and RF Interference Suppression.
- .4 IESNA LM-79-08, IES Electrical Method for the Electrical and Photometric Measurements of Solid State Lighting Products.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Electrical General Requirements Section for all light fixtures supplied under this contract.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.
- .3 Photometric data to include: VCP Table spacing criterion.

**1.3 SCOPE**

- .1 This contractor is responsible to supply and install all lighting fixtures as scheduled and/or indicated including lamp and those accessories required for a complete lighting system. This contractor must coordinate lighting installations with all other Divisions of this project.
- .2 All fixtures must be CSA approved or approved at this contractor's expense by the Special Inspection Division of the Electrical Safety Authority.

**1.4 GUARANTEE**

- .1 Guarantees for materials replacement shall be as follows from date of ready for takeover.
  - .1 LED fixtures, and driver: 5 years.
- .2 The labour required to replace these drivers must be included in the above guarantee, however only for the extent of the contract guarantee and warranty period as noted in Electrical General Requirements.

## **Part 2            Products**

### **2.1                FIXTURE CONSTRUCTION**

- .1        Fixtures must be constructed of 20 gauge (minimum) cold rolled steel. All metal edges require smooth finish.
- .2        Light leaks must be prevented by providing gasketting, stops, and barriers.
- .3        Fixtures must be finished in high reflective baked white enamel. This surface must have a reflectance of not less than 85%.
- .4        **All fixtures operating on 347 Volts must be provided with an integral disconnecting means.**

### **2.2                FIXTURE LENS**

- .1        Unless otherwise noted fixture lenses shall be as follows:
  - .1        Lens thickness: 3.2 mm (1/8")
  - .2        Material: injection moulded clear prismatic virgin acrylic
  - .3        Frame: hinged, latched, steel.

### **2.3                LED FIXTURES**

- .1        Fixture LED's must be tested in conformance with IESNA LM80 standard.
- .2        LED's must be selected using a binning algorithm to ensure colour and lumen output of a given fixture are consistent, as well as meet or surpass ANSI C78.377 specification for the rated lifetime of the fixture. Colour accuracy between products must be within a 2-step MacAdam ellipse.
- .3        Luminaires must be tested to IESNA LM79 by an independent approved laboratory.
- .4        Luminaires must be tested prior to shipping.
- .5        Luminaires must be ULC certified and approved for use in Canada.
- .6        Fixtures must maintain a minimum of 90% of their initial light output for 60,000 hours. Submit test results upon request.
- .7        Lumen values indicated for fixtures in the project documents are to be considered as "absolute" or "delivered" values.
- .8        Other than for specialty fixtures, and unless otherwise indicated, the maximum driver current is to be 750 mA.

### **2.4                STANDARD EXIT LIGHTING UNITS**

- .1        Exit lighting units must conform to CSA C860, CSA 22.2 No. 141 (latest edition).
- .2        Housing: extruded aluminum housing, white finish.
- .3        Face and back plates: extruded aluminum.
- .4        Lamps: 2W LED.
- .5        Operation: 25 year.

- .6 Units are to be provided with three (3) pictogram legends indicating “left from here”, “straight from here”, and “right from here”.
- .7 Face plate to remain captive for relamping.

## **2.5 SELF-POWERED COMBINATION EXIT/EMERGENCY LIGHTING UNITS**

- .1 Exit lighting units must conform to CSA C860, CSA 22.2 No. 141 (latest edition).
- .2 Housing: extruded aluminum housing. White Finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps 2W LED (EXIT).
- .5 Operation: 25 year life.
- .6 Units are to be provided with three (3) pictogram legends indicating “left from here”, “straight from here”, and “right from here”.
- .7 Face plate to remain captive for relamping.
- .8 Supply voltage: as noted on drawings.
- .9 Output voltage: 12 V DC.
- .10 Battery: sealed maintenance free 10 year life.  
  
Note: Battery must be capable of supplying the wattage indicated for a minimum of 30 minutes.
- .11 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
- .12 Solid state transfer circuit.
- .13 Signal lights: “AC Power On” condition and “charging” condition.
- .14 Lamp heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: minimum 4 watt LED.
- .15 Mounting: suitable for universal mounting directly on junction box and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .16 Cabinet: finish: white.
- .17 Auxiliary equipment:
  - .1 Test switch.

## **2.6 EMERGENCY LIGHTING UNITS**

- .1 Emergency lighting units must conform to CSA C22.2 No 141 (latest edition).
- .2 Supply voltage: as noted on drawings.
- .3 Output voltage: 12 V DC.

- .4 Battery: sealed, maintenance free, 10 year life.  
Note: Battery units must be capable of supplying the wattage indicated for a minimum of 30 minutes.
- .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.
- .6 Solid state transfer circuit.
- .7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .8 Signal lights: "AC Power ON" condition and "charging" condition.
- .9 Lamp heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: minimum 4 watt LED.
- .10 Cabinet suitable for direct or shelf mounting to wall and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .11 Auxiliary equipment:
  - .1 Test switch.
  - .2 Ac input and DC output terminal blocks inside cabinet.
  - .3 Shelf.
  - .4 Cord and plug connection for AC.

## **2.7 REMOTE EMERGENCY LIGHTING FIXTURES**

- .1 Remote emergency lighting fixtures must conform to CSA C22.2 No141 (latest edition).
- .2 Fixtures shall be small "micro" size or recessed style as indicated in the Light Fixture Schedule.
- .3 Fixtures must be adjustable type heads with canopy.
- .4 Fixtures are to be provided with protective lexan cube when specified in the Light Fixture Schedule.
- .5 Unless otherwise indicated surface mounted fixtures in washrooms, locker rooms, changerooms, and gymnasiums must be provided with wire guard.

## **2.8 ACCEPTABLE LIGHTING MANUFACTURERS**

- .1 Refer to the light fixture schedule as indicated on drawings.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated. Luminaires are not to be supported from the roof deck. Provide additional unistrut support channel and/or support from structure. Co-ordinate with consultant on site.
- .2 Ball align hangers must be provided for rod suspended fixtures.

- .3 Fixtures surface mounted to suspended ceilings must be secured through ceiling assembly to cross member supports. These supports are to be steel channels or angles independently secured **to structure** using # 12 “jack” chain. Each chain must be secured so no fixture weight is added to the ceiling assembly.
- .4 Plaster frames/flange kits must be provided by this Division for fixtures recessed in plaster and/or drywall ceilings.
- .5 Where specified, fixtures to be chain hung shall be hung using “jack” chain with a capacity to suit the fixture weight. Branch circuit wiring feeding these fixtures shall be AC90 cable “ty-wrapped” at 900 mm (36") intervals along length of drop. Final appearance must be neat and professional.
- .6 Install exit lighting units with illuminated faces and chevrons/arrows indicating path(s) of exit as indicated. Unless otherwise noted install exit fixtures at 2400 mm (8'-0") above finished floor.
- .7 Install emergency lighting units and associated remote mounted fixtures as indicated.
- .8 Direct “heads” on units and remote mounted fixtures to illuminate path(s) of exit.
- .9 Install emergency lighting units and remote fixtures at 300 mm (12") below finished ceiling, unless indicated otherwise.
- .10 Provide a 15 A 120 V duplex receptacle (connected to circuit indicated) adjacent to unit. **This receptacle connection is to be no lower than 8'-0" (2400 mm) AFF.**
- .11 **Special installation: Secure fixtures to structure to conform to the Electrical Safety Code using “jack chain” NOT ceiling suspension wire. Where coreslab is used, suspension point must be independent of the one used for suspension of the ceiling assembly. As an alternate to jack chain the contractor may use a pre-manufactured aircraft cable suspension and fastening system as manufactured by Gripple (Gripple Cat. #HF02-10F2). Provide minimum 2 per fixture.**
- .12 All battery units are to be provided with a visible lamicoid label indicating the unit number as per drawings.

### 3.2 WIRING

- .1 Connect luminaires to lighting circuits as indicated.
- .2 Connect exit fixtures to exit lighting circuits and unit equipment (if applicable).
- .3 Connect unit equipment to circuits as indicated.
- .4 All wiring of remote emergency fixtures shall be minimum #10 T90 for each circuit and run in conduit. Wiring must be sized in conformance with manufacturer’s recommendations for distances required.

### 3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.



### **3.4 DELIVERIES**

- .1 Fixtures are to be completely assembled at the manufacturer's plant and delivered to the project site in original unitized containers. Ensure that a dry, protected and secure space is available for proper storage before scheduling delivery of fixtures.

### **3.5 TESTING/CERTIFICATION**

- .1 At the completion of the project and in the presence of the consultant, test all exit and emergency fixtures. On company letterhead, the contractor is to prepare a chart indicating:
  - .1 Project
  - .2 Date
  - .3 Equipment type
  - .4 Certification of correct connection
  - .5 Certification of correct operation
  - .6 Duration of test in minutes (minimum 30)
  - .7 Actual period of testing (time of day)

### **3.6 INTEGRATED LIFE SAFETY SYSTEM TESTING**

- .1 This electrical contractor shall participate in integrated testing of this life safety system in conformance with Electrical General Requirements. Include all associated costs in tender.

### **3.7 ADDITIONAL INSTALLED EXIT SIGNS**

- .1 The electrical contractor is to include in their bid the cost to add two (2) additional standard exit lighting units to be installed and tested in locations as directed by the consultant. Note: This installation and test will be occurring after the initial testing/certification testing is complete.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE).
- .2 Underwriter Laboratories of Canada (ULC).
- .3 International Electrotechnical Commission.
- .4 International Organization for Standardization (ISO).
- .5 National Electrical Manufacturers Association (NEMA).

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 26 01 16.
- .2 Submit composite wiring diagrams and control schedule for each room control circuit type as proposed to be installed. Include load type, sequence of operation, sensor parameters, time delays, sensitivities and daylighting set points.
- .3 Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

**1.3 SCOPE**

- .1 This contractor is responsible to supply and install all equipment and control wiring as specified for the digital occupancy and daylight control systems. This contractor must coordinate these control systems with the lighting fixtures being supplied for the project to ensure intended function as specified.
- .2 Control Intent: Control Intent includes, but is not limited to:
  - .1 Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
  - .2 Initial sensor and switching zones.
- .3 All equipment must be CSA approved or approved at this contractor's expense by the Special Inspection Division of the Electrical Safety Authority.
- .4 Reference section 26 51 13 for Lighting information.
- .5 Reference section 26 05 75 for line voltage occupancy sensors and switches (hard wired analog).

**1.4 SYSTEM DESCRIPTION AND OPERATION**

- .1 The Digital Lighting Control (room level) as defined under this section covers the following equipment:
  - .1 Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay controllers.

- .2 Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
- .3 Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
- .4 Digital Photosensors – Single-zone closed loop sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.
- .5 Configuration Tools – Handheld remote for room configuration provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from an accessible location.

## **1.5 LIGHTING CONTROL APPLICATIONS**

- .1 Provide a minimum application of intended lighting control functions as detailed on design drawings and specified herein. Control functions shall include the following:
  - .1 Space Control Requirements – Provide occupancy/vacancy sensors with Manual-ON functionality in all spaces except toilet rooms, storerooms, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors.
  - .2 Bi-Level Lighting – Provide single zone, multi-level controls in any enclosed office, conference room, meeting room, and training room in all enclosed spaces except where variable dimming or multi-zone switching is used.
  - .3 Daylit Areas – All luminaires closest to the daylight source, and zoned separately from other fixtures in the space, shall be controlled separately from luminaires outside of daylit zones. Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings.

## **1.6 WARRANTY**

- .1 Provide a five-year complete manufacturer's warranty on all products to be free of manufacturers' defects.
- .2 The labour required to replace these products must be included in the above warranty, however only for the extent of the contract guarantee and warranty period as noted in Electrical General Requirements.

## **1.7 QUALITY ASSURANCE**

- .1 Manufacturer: Minimum 10-years experience in manufacture of lighting controls.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Basis of design product: WattStopper Digital Lighting Management (DLM). Acceptable alternates are subject to compliance and prior approval with specified requirements of this section, as one of the following:
  - .1 Cooper Controls (Wavelinx).
  - .2 Acuity Controls (nlight).
- .2 Substitutions:
  - .1 All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 7 working days prior to the bid date and must be made available to all bidders.
  - .2 By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

**2.2 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM**

- .1 Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.
- .2 Digital Occupancy Sensors shall provide calibration and electronic documentation for the following features:
  - .1 Digital calibration and pushbutton programming for the following variables:
    - .1 Sensitivity – 0-100% in 10% increments
    - .2 Time delay – 1-30 minutes in 1 minute increments
    - .3 Test mode – Five second time delay
    - .4 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    - .5 Walk-through mode
    - .6 Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
  - .2 Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
  - .3 Device Status LEDs including:
    - .1 PIR Detection
    - .2 Ultrasonic detection
    - .3 Configuration mode
    - .4 Load binding
  - .4 Manual override of controlled loads.
  - .5 One or two RJ-45 port(s) for connection to DLM local network.

- .3 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

## **2.3 DIGITAL WALL SWITCHES**

- .1 Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5, and 8 button configuration; colour per architect, compatible with wall plates with decorator opening. Wall switches shall include the following features:
  - .1 Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
  - .2 Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
- .2 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- .3 The following switch attributes may be changed or selected using a wireless configuration tool:
  - .1 Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
  - .2 Individual button function may be configured to Toggle, On only or Off only.
  - .3 Individual scenes may be locked to prevent unauthorized change.
  - .4 Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- .4 Two RJ-45 ports for connection to DLM local network.
- .5 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- .6 WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101.

## **2.4 DIGITAL POWER PACKS (ROOM CONTROLLERS)**

- .1 Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
  - .1 Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
  - .2 Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.

- .3 Device Status LEDs to indicate:
  - .1 Data transmission
  - .2 Device has power
  - .3 Status for each load
  - .4 Configuration status
- .4 Quick installation features including:
  - .1 Standard junction box mounting
- .5 Plenum rated
- .6 Manual override and LED indication for each load
- .7 120 VAC, 60 Hz operation.
- .8 Zero cross circuitry for each load.
- .2 On/Off Room Controllers shall include:
  - .1 One or multiple relay configuration to suit control details
  - .2 Efficient 150 mA switching power supply
  - .3 Sufficient sensor connection points to suit indicated function without the requirement for additional hardware
  - .4 Discrete model listed for connection to receptacles, for schedule-based control of plug loads within the space.
    - .1 One relay configuration only.
    - .2 Automatic-ON/OFF configuration.
    - .3 Optional Network Bridge for BACnet MS/TP communications
  - .5 Three RJ-45 DLM local network ports.
  - .6 WattStopper product numbers: LMRC-101, LMRC-102, LMPL-101, LMPL-201.
- .3 On/Off Room/Dimming enhanced Room Controllers shall include:
  - .1 One or multiple relay configuration to suit control details.
  - .2 Efficient 250 mA switching power supply.
  - .3 One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
  - .4 The following dimming attributes may be changed or selected using a wireless configuration tool:
    - .1 Establish preset level for each load from 0-100%.
    - .2 Set high and low trim for each load.
    - .3 Set lamp burn in time for each load up to 100 hours.
  - .5 Four RJ-45 DLM local network ports.
  - .6 Optional Network Bridge for BACnet MS/TP communications.
  - .7 WattStopper product numbers: LMRC-211, LMRC-212, LMRC-213, LMPL-201, LMRC-311, LMRC-312, LMRC-313.

## **2.5 DIGITAL ROOM CONTROL SYSTEMS**

- .1 Digital occupancy and daylight control system designed to control a small area of a building (room level). Digital devices connect to the room controller(s) using CAT 5e cables (LMRJ) with RJ-45 connectors which provide both data and power to room devices. Features of the system shall include:
  - .1 Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
  - .2 Simple replacement of any device in the system with a standard off the shelf unit without requiring commissioning, configuration or setup.
  - .3 Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices which are part of the local system.
  - .4 Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

## **2.6 CONFIGURATIONS TOOLS**

- .1 A configuration tool facilitates optional customization of digital lighting control system featuring infrared communications.
- .2 Features and functionality of the wireless configuration tool shall include:
  - .1 Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
  - .2 Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.
  - .3 Save up to nine occupancy sensor setting profiles and apply profiles to selected sensors.
- .3 WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- .2 When using wire for connections other than the DLM local network (LMRJ Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements.

- .3 Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
  - .1 Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.
- .4 Install power packs in accessible maintenance areas unless noted otherwise. Provide access doors if power packs are installed above drywall ceilings.
- .5 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper coverage within the range of coverage as per the manufacturer's recommendations. 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 rooms.
- .6 Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
  - .1 Sensor parameters, time delays, sensitivities, and daylighting setpoints.
  - .2 Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
  - .3 Load Parameters (e.g. blink warning, etc.)
- .7 Re-commissioning – After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

### **3.2 FACTORY COMMISSIONING**

- .1 Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- .2 The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.
- .3 Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.
- .4 Factory commissioning shall include functional testing and documentation of the control system conforming to the "Functional Testing" requirements included in the current ASHRAE standard. This cost shall be included in the Tender Price.

### **3.3 INTEGRATED LIFE SAFETY SYSTEM TESTING**

- .1 This electrical contractor shall participate in integrated testing of this system in conformance with Electrical General Requirements. Include all associated costs in tender.

**END OF SECTION**



**APPENDIX A**  
**County of Brant – Network Infrastructure Design Standards**



# **Network Specifications**

## **Network Infrastructure Design Standards**

*Adapted for New Construction Projects*

**Date:** June 30, 2025

## **LIMIT OF LIABILITY ASSOCIATED WITH THIS DOCUMENT**

### **GENERAL LIMITS**

This package includes general product specifications, design considerations, and installation guidelines. In case of discrepancies, this document holds precedence. The contractor must meet or exceed all requirements outlined in this document for the cabling system.

The County of Brant mandates the installation of network cabling at the specified location. This document outlines the criteria for supplying and setting up a certified Cat 6 cabling system. It entails a balanced plenum Cat 6 UTP twisted-pair cabling infrastructure, detailed herein.

The cabling system is tasked with delivering data cables from each Network Jack in designated areas to the demarcation point in the Network Operations Center (NOC). The contractor is obliged to terminate cables at the Network Jacks and the NOC patch panel (provided by the contractor). No permanent link should exceed 90 meters (295 feet) from termination points at each end. An additional 10 meters (33 feet) is allowed for cordage at both ends, allowing for a maximum end-to-end or channel length of 100 meters (328 feet). Refer to drawings for precise quantities and locations.

For IP-based security device runs surpassing the distance limit, the cabling contractor must supply fiber optic cabling with media converters, along with necessary terminations, connections, and hardware.

The contractor is responsible for furnishing, configuring, installing, terminating, testing, labeling, and documenting all cables, as specified in this document. Additionally, the contractor assumes responsibility for fire stopping.

This document is to be used as a standard for County of Brant networking and telecommunications cabling infrastructure.

## **DESIGN STANDARDS AND REGULATORY REFERENCES**

All workmanship and materials supplied shall be in full conformance with applicable building, electrical, and other codes, as determined by any authority having jurisdiction.

All cabling system components shall be Canadian Standards Association (CSA), or Underwriters Laboratories (UL) Listed and shall be marked as such. In cases where CSA/UL has no published standards for a component, any equivalent national independent testing standard shall apply, and the item shall be appropriately marked. Where CSA/UL has an applicable system listing and label, the entire system shall be labeled.

The product specifications, design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. The following are used references:

### **SPACES AND PATHWAYS**

- ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces

### **GROUNDING**

- ANSI-J-STD-607-B – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

### **CABLING SYSTEMS**

- ANSI/TIA 568-C.0 Generic Telecommunications Cabling for Customer Premises.
- ANSI/TIA 568-C.1 Commercial Building Telecommunications Cabling Standard.
- ANSI/TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components

Standards.

- ANSI/TIA 568-C.3 Optical Fiber Cabling Components Standard.

## **CABLING ADMINISTRATION**

- ANSI/TIA -606-B– Administration Standard for Commercial Telecommunications Infrastructure

## **NETWORKING**

- IEEE Standard 802.3 ethernet standards

## **DESIGN**

- BICSI Telecommunications Distribution Methods Manual (TDMM) – 13th edition.

## **INSTALLATION**

- BICSI Information Technology Systems Installation Methods Manual (ITSIMM) – 6th edition.
- In cases where product specifications, design considerations, and installation guidelines provided in this document conflict with the references listed above, the more stringent requirements shall apply. All latest publications to be used.
- This document does not take precedence over any code, either partially or wholly.

## **CABLE MANUFACTURERS**

- The cabling contractor will supply all Cat 6 cable from a single manufacturer and shall be new and fully tested, certified, and warranted by the manufacturer.
- All termination points will be supplied from a single manufacturer and shall be fully tested, certified and warranted by the manufacturer, this includes keystones, patch panels, etc
- All manufacturers' products installed must meet or exceed all local, provincial and federal building, fire, health, safety and electrical codes.
- All manufacturers' products must meet or exceed the specifications in this document. No alternatives will be accepted except where noted. Cabling contractors must identify alternative products with their bids, including the manufacturer and part number.
- The Cabling Contractor shall accept complete responsibility for the installation, acceptance testing, defect remediation and certification of the successful system.
- The successful cabling contractor and their manufacturer must be able to install and support a minimum 20-year warranty.
- Accepted cable manufacturers are:
  - General Cable
  - Belden
  - Panduit
  - CommScope

## **APPROVED INSTALLERS**

- The cabling contractor can be a union or non-union authorized certified Cabling Contractor.
- The Communications Cabling Contractor may not assign or sub-contract any work without the prior written consent of County of Brant Inc. or their designated representative.
- All installation and testing shall be performed by certified individuals and supervised by competent and qualified individuals to install and test the horizontal cabling in accordance with manufacturer requirements. The supervisor(s) shall have successfully completed the manufacturer training courses and be able to provide documentation of successful completion of such training upon request.
- The Project Manager and lead tech that starts the project shall remain on the project until its completion. Changes to the Communications Cabling Contractor's project team may only occur

with the prior consent of County of Brant Inc.

- The Communications Cabling Contractor must comply with all job-site requirements (including The Fair Wage and Hours of Labour regulation) for the duration of the project. The Communications Cabling Contractor shall make all necessary allowances to comply with labour requirements of all unions on site to ensure that there will not be any disruption of work arising from the successful cabling contractors work or workers.
- The Communications Cabling Contractor must comply with all requirements of the Occupational Health & Safety Act.
- It shall be the Communications Cabling Contractor responsibility to be aware of all current or impending legislation relating to employees, safety and fire regulations and are required to acquaint provide their staff with this information.
- The Communications Cabling Contractor shall be responsible for being aware of all governing local municipal regulations and the Provincial Employment Standard concerning minimum wages, vacation pay, termination of employment etc.
- The Communications Cabling Contractor must be in good standing with the Workplace Safety and Insurance Board and the successful cabling contractor will be required to provide to the client a clearance certificate (Workers Compensation) to this effect.
- The Communications Cabling Contractor agrees to use only tradespeople who are fully trained, qualified and experienced on the installation, termination and testing of a Certified Communication Cabling System.
- If working at heights is required at any point during the project, the Communications Cabling Contractor must be trained to work at heights and shall have the appropriate documentation/qualifications to demonstrate that they have successfully completed that requirement.

## PRODUCTS

### UTP CONNECTORS

The connectors used to terminate the 4-pair balanced twisted-pair cable shall have the characteristics listed below.

- The connectors shall be modular in form, with available mounting options for Network Jacks and angled type patch panels.
- County preference is for keystones and patch panels to be the same as, or approved by the cable manufacture; however, consideration will be given to similar should the warranty, certification and specifications be equivalent.
- When mated to cordage, the transmission characteristics of the connectors will be guaranteed to 250MHz.
- The **BLUE** Cat6 data RJ45 module in the faceplate and in the respective 24/48 port modular angled type patch panel.
- The **PURPLE** wireless Cat6 data RJ45 module will be required for each wireless AP location installed in a 2-port surface box and in the respective 24/48 port modular angled type patch panel.
- The **YELLOW** IP camera Cat6 data RJ45 module will be required for each camera location installed in a 2-port surface box and in the respective 24/48 port modular angled type patch panel.
- The **YELLOW** Door Access Controller Cat6 data RJ45 module will be required for each Access controller location installed in a 2-port surface box and in the respective 24/48 port modular angled type patch panel.
- All RJ45 modular jacks shall be 8-position, terminated in a T-568A sequence.
- The Installer shall confirm all part numbers and colours before ordering with the County of Brant.

## MODULAR ANGLED PATCH PANELS

- Each rack/cabinet mountable angled modular patch panel shall be either 24 port (1U), 48port (2U) modular type patch panels from the same manufacturer of the Modular Connectors.
- All patch panels mount in 19" EIA standard mountings.
- Each connector colour shall be terminated in its corresponding colour-coded patch panel.
- All cables to be terminated in contractor supplied patch panels.

## UTP PATCH CORDS

The work area cords, patch cords, shall have the characteristics listed below.

- The cordage shall use 23/24 AWG solid or stranded copper conductors in a bonded pair configuration for reliable long-term channel performance to 250MHz.
- The cordage shall be available in multiple colors and lengths from the same manufacturer as the horizontal cabling. (not site prepared)
- All Patch cords are to be 8-position, terminated in a T-568A sequence.
- Supply and install all patch cords as listed below.

CAT6 Patch Cords	Length	Quantity
BLUE CAT6-Workstation and Locations	7'-0"	One per data drop
PURPLE CAT6-Wireless Locations Slim 2 cables required one for wireless and one for Patch Panel	4'-0"	One per Access point and one for Patch Panel
YELLOW CAT6-Door Access Rack Slim cable required and	4'-0"	One per Door and one for Patch Panel
YELLOW CAT6-IP Camera Locations-Slim cable required	4'-0"	One per camera and one for Patch Panel
BLUE CAT6-Telecommunications Rack Slim cable required one for each workstation locations	4'0"	One per data drop

## HORIZONTAL CABLE

- Supply and install a horizontal cable tray above the telecommunications rack. All cabling entering the telecommunications rack must entry from the horizontal cable tray into the top of t
- Horizontal cables shall not be attached to ceiling grid support rods, conduits, water pipes HVAC ducts or lighting fixture wires. Where support for horizontal cable is required, the Communications Cabling Contractor shall install appropriate sized J hooks to support the horizontal data cabling.
- Horizontal cables shall be installed above fire-sprinkler systems and shall not be attached to such systems.
- At no point shall any horizontal cable(s) rest on or be supported by acoustic ceiling grids hangers, water pipes, HVAC, metal conduits or ceiling panels.
- Label all cables in accordance with this document and 606-B Standards. One label should be attached to the front of the workstation faceplate, one to the front of the patch panel, and one within 4 inches of each end of the horizontal UTP cable.
- All data cables will be plenum rated (CMP). The minimum recommended installation temperature shall be 5 °C (40 °F). The temperature rating shall be 60 °C (140 °F).
- The colour of the horizontal and Cat6 data cabling shall be BLUE.
- The cables shall have randomization elements along their lengths and on their cross- sections to minimize alien near-end crosstalk (ANEXT) coupling.

- The cable conductors shall be 23/24 AWG solid copper. No Aluminum Copper Cladding (ACC) will not be accepted.
- The minimum bend radius shall be no greater than four times the OD of the cable.
- Cables shall be neatly bundled, dressed, and routed to their respective termination connectors.
- Exact layout and termination of the data cables in the patch panels within the data racks and data cabinets may change.
- Each cable shall be clearly labeled on the cable jacket within 4 inches of the termination behind the RJ45 type connector at each end. Labels obscured from view will not be acceptable and will be replaced by the Communications Cabling Contractor at no cost to County of Brant

## CABLE INSTALLATION

Cables and Jacks shall be dressed and terminated in accordance with:

- Standards-based recommendations.
- The manufacturer's recommendations and installation guides.
- Industry best practices.
- Slack cable to be coiled if adequate space is provided to house the slack cable without exceeding the manufacturer's installation guidelines.
- Where possible, include **10 feet** of slack at the workstation location (stored in accordance with manufacturer's installation guidelines) to allow for future outlet relocation.
- Bend radius of the cable in the termination area shall not be less than 4 times the OD of the cable.
- The data Cat6 RJ45 connectors at the outlet will be **BLUE** in colour for all new Cat6 cabling Blanks to match faceplate color.
- Those connections not for data shall have connectors matching the colour of the patch cords as specified above.
- All cable ties shall be black Velcro style. Plastic cable ties (zip ties) are not allowed. If found on site during any phase of the project, the plastic cable ties will be removed, along with all cabling components contained within them, and the removal and the re-cabling shall be at the Communications Cabling Contractor's expense.
- Where required, the Communication Cabling Contractor is to coordinate with the furniture supplier on site. Furniture manufacturer to be engaged by the General Contractor.
- Include all necessary surface type or flush furniture faceplates/boxes/adapters/spacers/HD jacks etc. to ensure the faceplate can be properly installed or secured at the furniture, walls, floor boxes and conference room tables while maintaining a proper bend radius.
- Horizontal cabling shall use a 1" (25mm) conduit from each outlet location to the ceiling space. Cable support hangers shall be used where the conduit ends, routing the cabling to the cable tray system, which will terminate in the telecommunications room.
- All horizontal telecommunications cabling shall be based on a physical star topology.
- The Communication Cabling Contractor to supply and install the cover plates for locations where ganged with electrical or stand alone.
- A minimum of TIA/EIA 568 Category 6 UTP four pair cabling shall be installed for all horizontal telecommunications cabling.
- Unless agreed with the Construction Contractor, the Communications Cabling Contractor is responsible for the removal and re-installation of all ceiling/floor tiles in the areas affected by its work. This is to be completed daily for the areas affected.
- Any damage to ceiling tiles during the completion of any work outlined in this document is the responsibility of the Communications Cabling Contractor. Damage includes breaking, chipping or fingerprints. The decision with respect to any damage will be made by the General Contractor Project Manager and the Owner.
- Pair untwist at the termination point shall not exceed 13 mm (0.5 in)
- All areas will be wired to provide as much flexibility as possible so that moves, adds and changes to furniture or drop locations can enable reuse of the cabling. Terminate all wiring with the cable length being able to reach the farthest point in the areas being served.
- The horizontal cabling system shall support such systems as network access,

telephony/VoIP, Wireless Access Points, access control and surveillance, intrusion detection, audio visual, etc.

- All jacks shall have 2 Cat6 cables terminated unless otherwise specified.
- The facility shall have wireless coverage in requested areas, following the best practice of using two cables per 70-foot diameter grid. This approach allows for flexibility in the placement of Wireless Access Points. A heat map or coverage study is not required.
- All new UTP horizontal voice and data cabling shall terminate on new modular patch panels. Patch panels shall be located within racks inside the telecommunications closets.
- Where possible, for all wireless locations include **10 feet** of slack for future relocation.
- Where possible, for all Camera and Door Access locations include **5 feet** of slack for future relocation.
- All horizontal telecommunications cabling shall have a CMP (FT-6) rated jacket as applicable.
- The County of Brant is not responsible or liable for any missing material and/or tools belonging to the Communications Cabling Contractor.

## **BACKBONE CABLING SYSTEM (where required)**

### **Fibre Optic Backbone Cabling**

- The fibre-optic cable design shall use multimode cable.
- All Fibre cables shall meet minimum 10 Gb/s and higher speed standards.
- All fibre cable will be housed on a 1" (in) 25 mm orange corrugated inner duct.
- All fibre cabling will be OFNP (FT-6) rated jacket as applicable,
- All fiber cables shall be terminated in a LC-UPC Rack Mount Enclosure Box & Splice Tray
- All connectors shall be LC connectors.
- All fibre cable shall have all strands terminated in patch panels.

## **TELECOMMUNICATIONS SPACES AND PATHWAYS**

### **Data Racks**

- Frames are to be constructed of rugged 11 GA (0.120") steel and rigid.
- Frames are to be standard height of 7'-0" with 44 U of usable space and with 19" EIA 10-32 tapped mounting holes on each side with permanently marked U-spacing identification.
- Frames to have a 5/16" sturdy steel base with anchor holes for mounting to floor and adjustable to 42".
- The data rack is standard with 1 copper 2-hole 10-32 x 0.5" L ground stud.
- One 19" x 18" modem shelf (black)
- Approved manufactures are (Hammond, Eaton/Tripp lite, APC, or approved manufacturer).

### **Data Rack Vertical Wire Managers**

- Frame black smooth paint finish.
- Fabricated of 16 GA (0.060") steel
- The vertical cable manager shall have a hinged door(s) with a positive locking mechanism (non-magnetic).
- The openings for cable routing shall have fingers (not grommet) to ensure a smooth transition of the patch cords.
- The vertical wire managers shall be a minimum of 8" w and 8" d.
- Approved manufactures are (Hammond, Eaton/Tripp Lite, APC, or approved manufacturer).
- Vertical wire manager to be the same manufacture as the data rack.



### Horizontal and Vertical Power Bar

- Fabricated from 18 GA (0.048") steel.
- Slim profile power bars mount into 19" EIA cabinet frames or network racks.
- Features no reset button, three-prong power cord and power outlets.
- Illuminated power switch showing power "ON".
- Comes standard with a 6-10' power cord.
- Comes standard in 100v 20-amp capacity.
- Comes with a minimum of 8 outlets.
- Vertical power bar to be supported in the four 4 post frames.
- Horizontal power bar to be installed in the wall mount data cabinet

### Network Operations Center (NOC) Requirements

- The NOC is an area for terminating and cross-connecting the horizontal and backbone cabling and for containing active or passive networking and telecom equipment.
- Primary NOC shall always be on the ground level floor.
- Each NOC shall have a minimum of one four post data rack with vertical cable management, with provision for a second four post rack
- Four post racks will be supplied by contractor.
- Location of 4 post racks to be determined in consultation with the County Of Brant.
- The locations of NOCs shall be designed to ensure that each network port inside the NOC and each device endpoint serviced by the NOC, including potential endpoints that may be added in the future at the farthest possible distance within the NOC's service area, can be reached from a NOC using 90 meters of cable.
- Further Cabling closets shall be required for buildings with more than one floor. This will be assessed on a case by case basis.
- More than one NOC is required if horizontal cable run lengths exceed 290ft.
- NOC shall have a lock that is separate from the building Master. IT services shall be the sole keeper of any keys associated with the NOC.
- Locations near potential sources of electromagnetic interference, will be avoided.
- The minimum NOC size shall be 10'x10'. Larger size may be required based on a case-by-case basis.
- The Cabling Closet size shall be a minimum of 6'x6'.
- Each cabling closet shall have a minimum of a 12U swing out wall mount cabinet with lock
- Minimum size for Wall Mount Cabinet shall be no less than 24 inches wide by 32 inches deep with a minimum weight rating of 300 lbs.
- One wall in the NOC shall be lined with a 4'X8'X3/4" Exterior Grade Plywood.
- Floor treatments shall be anti-static.

### Electrical Requirements

- The contractor is responsible for the complete installation of all cable trays, wire raceways, conduits, pull boxes, surface type or flush faceplates/boxes/adapters/spacers/HD jacks, floor boxes, gangs, surface boxes, sleeves, and floor and wall penetrations needed to support communication systems.
- All electrical requirements shall be provided by the electrical contractor.
- NOC rooms shall be equipped with a minimum of two NEMA 5-20 and two NEMA 5-15 receptacles per equipment rack, including any provisional racks. Future racks, as defined by the County of Brant, shall also require the same receptacle configuration. It is recommended that these outlets be connected to generator or UPS power where available
- A licensed electrical contractor shall perform the installation and termination of the main bonding

conductor to the building service entrance ground.

- The grounding and bonding approach recommended in this specification shall meet the requirements of all current Canadian codes and standards and is intended to work in concert with the cabling topology as specified in this document.
- Grounding to the conduit system or cold-water pipes will not be permitted.
- One #6 AWG ground wire shall be installed with proper two-hole lug mounting hardware from the data rack by the Communications Cabling Contractor
- One #6 AWG ground wire shall be installed with proper two-hole lug mounting hardware in the communications demark room by the Communications Cabling Contractor
- Ensure that metal to metal contact is made when grounding to paint or powder coated surfaces for all patch panels.

#### Fire Protection:

- Fire protection shall be provided by the mechanical contractor.
- Active Water lines and sprinkler heads shall not pass through or terminate inside the NOC. Alternative dry suppression or dry pipes with sprinkler heads shall be considered on a case-by-case basis.
- These areas shall be protected with an approved automatic fire detection system that will respond to visible or invisible particles of combustion.

#### Environmental Control:

- Environmental control shall be provided by the mechanical contractor.
- Provide continuous and dedicated environmental control (24 hours per day, 365 days per year).
- Temperature ranges should be maintained between 22°C, +/- 2°C. Relative humidity shall be maintained between 45% +/- 10%.
- Maintain a positive air pressure with a minimum of one air change per hour.
- Heat load information shall be provided by the client and based upon equipment quantity/type as well as growth.
- Supplementary cooling may be required for the telecommunications rooms. Refer to mechanical design brief for further information.

#### Entrance Facility

- The incoming cabled services from the street shall be terminated in the main telecommunication closet. The Entrance Facility is an area for terminating incoming cabled services from the street.
- The telecommunications duct banks shall include at least one 4" duct, starting at the property line and terminating in the main NOC. This pathway will be used for incoming services by the client's service provider(s).

## **EXEMPTIONS AND OWNER RESPONSIBILITIES**

#### Network Devices and Wireless Equipment

- The owner will be responsible for the provision of all network hardware (including voice services) and wireless related active equipment. This includes but is not limited to routers, servers, switches, firewalls, UPS's, etc.
- The owner shall also be responsible for the provision of all network peripheral devices such as telephones, computers, fax machines, printers, wireless node/antenna, etc.
- All related active equipment shall be considered as outside the scope of this document.

#### Incoming Third-Party Services

- Incoming services including network and telecommunication services shall be considered as outside the scope of this document and shall be considered the sole responsibility of the owner.

## **TESTING AND ACCEPTANCE**

- All terminated horizontal Cat6 cabling runs shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements found in the TIA/EIA-568-C series of standards. All pairs in each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation, including (but not limited to) cables, connectors, and cordage shall be repaired or replaced in order to ensure 100% usability of all installed runs.
- Failure to provide test results upon request will require the communication cabling contractor to retest all horizontal cabling related to the project with no cost to County of Brant.
- All horizontal permanent link tests are to be performed using a LEVEL III tester equipped with the most recent version of its firmware and in accordance with ANSI/EIA/TIA-568-C series standard.
- Upon completion of the testing by the Communications Cabling Contractor, the Communications Contractor may be asked to submit the test results for the various work activities to County of Brant within two business days. Provide one line summary in PDF in numerical order for review by County of Brant.
- All cable tests are to be performed using one of the approved testers equipped with the most recent version of its firmware and in accordance with ANSI/EIA/TIA- 568-C series of standards.
- Tester to be calibrated within one year of testing date.
- Contractor to provide documentation from tester manufacturer to reflect calibration date.
- Communication Cabling Contractor must have up to date training for one of the approved testers being used to test cabling.
- Contractor to provide documentation to reflect completion training dates.
- All launch cables and connectors shall be new.

## **DOCUMENTATION**

- Upon completion of the installation, the Communications Cabling Contractor shall provide two (2) marked up cable drawings indicating all cable drops ID's to the client within five (5) business days of prior to the network cutovers.
- Cable test report will indicate for all horizontal data cables when it was tested successfully, the result and the length

**Part 1 General**

**1.1 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Electrical General Requirements Section.
- .2 Submit shop drawings of materials and equipment to be supplied on the project. Submission shall include manufacturer, dimensions, appearance and specifications.
- .3 Submit shop drawings for jacks, copper cable, faceplates, patch panels, racks, cable managers, patch cords, wireless access points, etc.

**1.2 PRODUCT/MAINTENANCE DATA**

- .1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to Electrical General Requirements Section.

**1.3 SCOPE**

- .1 The scope of this Section will include the following systems.
  - .1 Voice/data network installations.

**Part 2 Products**

**2.1 VOICE/DATA NETWORK INSTALLATIONS**

- .1 Refer to the County of Brant Network Specifications (Dated June 30,2025) as per the appendix A.

**Part 3 Execution**

**3.1 VOICE/DATA NETWORK INSTALLATIONS**

- .1 Cabling Contractor is to adhere to all Standards, regulations and documents listed following.
- .2 All products installed must meet or exceed all local, provincial and federal building, fire, health, safety and electrical codes.
- .3 The responsibility of this sub-contractor is to include but not be limited to:
  - .1 Supply and installation of security camera, door access, and data cabling to every outlet as noted on the drawings.
  - .2 Termination of data cabling at outlet and distribution panel.
  - .3 Supply and installation of device faceplates in surface raceways and/or flush outlet boxes.
  - .4 Supply and installation of computer network rack or network cabinets and distribution panels required for a complete and operational system. Interface server computer and hubs will be supplied complete by the owner.

- .5 Testing in conformance with noted procedures.
- .6 Labelling of outlet faceplates and associated port on distribution panel. An “As Built” floor plan of “outlet addresses” must be provided at the completion of the project.
- .4 Co-ordinate work with owner’s Computer Services personnel.
- .5 The owner’s Network Integrator must be present on site to witness and co-ordinate the required system testing. The cabling contractor and the Network Integrator must together perform a job walk through upon completion of testing, together sign the cabling test reports to verify that network cabling is properly installed and performs to acceptable owner’s Standards.
- .6 The electrical contractor is to include all costs of the network sub-contractor in his tender. The electrical contractor must sub-contract and co-ordinate all work of the network sub-contractor.
- .7 General installation practices shall be as follows:
  - .1 Supply and install cabling to locations as detailed on floor plan(s). The Cabling Contractor shall use the cabling support system (supplied by Division 26) to distribute the cables throughout the facility. Where the cables leave the cable support system and extend to the termination point they shall use the conduit provided or cable management system.
  - .2 All Cables and components to be installed and terminated in accordance with CSA, ANSI/EIA/TIA-568 and its’ Amendments as well as UL Guidelines. Particular attention must be given to maintaining the integrity of the pair twists, bend radius and ensuring proper distance is kept from fluorescent light fixtures, electrical cables or any other source of EMI.
  - .3 Ensure ANSI/EIA/TIA-568A installation practices are followed. Cables are to be combed and bundled in a neat and organized manner. The owner’s representative and/or Consultant will determine neatness of the installation. Cables that have not been properly combed and dressed will have to be re-dressed at the Cabling Contractor’s expense. The Cabling Contractor shall co-ordinate with the Communications Consultant **prior** to termination in any communications room.
  - .4 The maximum horizontal run length is not to exceed 90 m (300'). If the 90 m (300') constraint cannot be met, the Cabling Contractor is to notify the Consultant of any cables that exceed 90 m (300'), prior to their installation.
  - .5 Any deviation from the cable routing, outlet and equipment locations shown on drawings must be approved by the owner/consultant and documented on as-built drawings.
  - .6 Avoid scraping, denting, or otherwise damaging cables, before, during or after installation. The Cabling Contractor without any additional compensation shall replace damaged cables.
  - .7 Ensure that all cable lengths are sufficient to allow for slack, vertical runs, wastage, connectorization and future moves.
  - .8 Bush, ream and remove any sharp projections on all conduits prior to installation of communications cables.

- .9 When terminating copper cables remove only enough cable jacket to perform termination, untwist pairs a maximum of 13 mm (1/2") for Category 6 cables.
- .8 Faceplates
  - .1 Jacks and/or connectors shall be terminated to the appropriate cable and inserted in the correct orientation into the faceplate prior to the mounting of the faceplate.
  - .2 Cable slack shall be stored behind the faceplate in such a way that allows the minimum bend radius of the cables to be maintained as per the following: Fibre Optic Cable, a minimum of 3 feet (1 m) slack with a minimum bend radius of 1.18 inches (30 mm). UTP cable, a minimum of 1 foot of slack with a minimum bend radius of 4 times the cable diameter. Care shall be taken when mounting the faceplate to avoid crimping or kinking the cables.
  - .3 Faceplates shall be securely mounted to a surface mounted housing, a recessed box, or box eliminator bracket.
  - .4 Faceplates shall be labelled with the appropriate port designations as per the EIA/TIA 606 standard.
- .9 Category 6 Jacks –UTP
  - .1 Jacks shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination to the jack IDC shall be no greater 0.5 inches (13 mm)
  - .2 Jacks shall be installed according to manufacturer's instructions and properly mounted in plates, frames, housings or other appropriate mounting device.
  - .3 Jacks shall be installed such that cables terminated to the jacks maintain minimum bend radius of at least 4 times the cable diameter into the IDC contacts. Cables shall be terminated on jacks such that there is no tension on the conductors in the termination contacts.
- .10 Horizontal Cabling
  - .1 Cable shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination shall be no greater than 0.5 inches (13 mm).
  - .2 Shall be installed according to manufacturer's instructions.
  - .3 Shall be installed such that cables can maintain minimum bend radius of at least 4 times the cable diameter. Cables shall be terminated in such a way that there is no tension on the conductors in the termination contacts.
  - .4 Shall be properly labelled on front and back with the cable number and port connections for each port.
  - .5 Shall be installed in one continuous length unless specified in the contract document.
  - .6 Adhere to TIA standard requirements regarding pulling tension and allowable lubricants.

- .7 The contractor shall assume the responsibility for any difficulties or damage to the cable during placement.
- .8 Contractor shall provide owner with all installed cable measurements.
- .9 Firestop all openings where cable is installed through a fire barrier.
- .10 All cables shall have sufficient slack for re-termination five times at both ends. Strain relief shall be provided sufficiently to secure cables to terminal panels. All cables are to be neatly tie-wrapped (plenum rated tie wraps) through wiring trays.
- .11 All data communication cables shall be separated from sources of electromagnetic radiation in accordance with TIA Standard proposal SP-2072 and the following:
  - .1 If both data and small power cables (2 KVA power circuits) are installed in grounded, ferrous metal conduit throughout the run, then no separation is required (i.e. EMT conduit).
  - .2 CMP (FT-6) rated data cabling with no metallic raceway and power conductors (2 KVA power circuits) in grounded raceway requires 5" (125 mm) clearance.
  - .3 For fluorescent luminaries the required clearance is 12" (300 mm).
  - .4 Clearance increased up to 24" (600 mm) for power circuits over 5 KVA.
  - .5 For large motor, transformer, power panels, etc, the required clearance is 40" (1 m).
  - .6 Cables must be routed to avoid direct contact with steam piping, hot water piping or other heat sources to avoid thermal degradation.
- .11 Testing
  - .1 The communications Contractor shall perform a full Cat. 6 test for every data drop installed in order to verify for a 1000 Mb/s solution.
  - .2 All tests shall be in accordance with ANSI/EIA/TIA-568B.1, section 11, Cabling Transmission Performance and Test Requirements.
  - .3 Category 6 field test parameters shall be:
    - Wiremap
    - Insertion loss
    - Equal-level far end cross-talk (ELFEXT)
    - Power sum Equal-level far end cross talk (PSELFEXT)
    - Propagation Delay
    - Length
    - Near end cross talk (NEXT)
    - Power sum near end cross talk (PSNEXT)
    - Return loss
    - Delay skew
  - .4 Voice cables shall also be tested for continuity, shorts, opens, grounds, correct polarity and length.
  - .5 Jacks shall be tested as part of the installed horizontal cabling system.

- .6 Category 6 Jacks shall be tested as part of the channel for Length, DC continuity, NEXT, PSNEXT, Attenuation, Return Loss, ELFEXT, and PSELFEXT using a level IIe tester for category 6 channel compliance.
  - .7 Test patch cords to portable tester must be designed for testing by the manufacturer. Field assembled patch cords are not acceptable. Field testers must use the appropriate jack/tester adapter specified for use with the cabling jack(s) specified within this document.
  - .8 The nominal velocity of propagation (NVP) must be set specific to each cable manufacturer before testing. Portable tester to be calibrated on a minimum annual basis.
  - .9 Testing of horizontal cables is to be completed in accordance with the following test criteria. The testing must be completed on the Channel Level. Testing is to be completed from both ends of the installed cable.
  - .10 Cabling Contractor to produce a test report based on the cable schedules. The report should indicate for each cable, when it was tested successfully and the signature of the technician that performed the test, location, cable type, cable number and tester make and model. A copy of the test report must be submitted to the Consultants for approval. The entire report must be signed by an authorized person for the Cabling Contractor at the end of the project.
  - .11 Correct all cable faults. Splicing of any cables will not be permitted, for any reason, unless prior authorization is received in writing from the Consultant.
  - .12 A "PASS" indication shall be obtained for all link or channel tests when tested using the appropriate level tester for the appropriate category.
  - .13 Testers shall be correctly set to test the type and manufacturer of the horizontal cable used in the link or channel being tested, including the correct NVP.
  - .14 The owner's Computer Services personnel will conduct a random audit of the newly installed wiring (time frame 90 days from completion) and if the failure rate is greater than 10%, the contractor will assume the cost of hiring a third party to complete a full audit of all the new network drops.
- .12 Test Results
- .1 Test results shall be submitted in hard and electronic format. Electronic reports shall be submitted in a Windows based database (Microsoft Excel is acceptable). All electronic reports must be accompanied by a certificate signed by an authorized representative of the company warranting the truth and accuracy of the electronic report. Hard copy of the report is to be submitted in triplicate in three individual binders.
  - .2 The test result documentation shall be submitted to the electrical contractor no later than 10 working days following the completion of the installation.
- .13 As-built Drawings
- .1 This contractor shall maintain an updated copy of as-built drawings on site at all times.



- .2 At the end of the project, this contractor shall obtain Autocad files from the Consultant and update them with the work performed by the contractor. This contractor shall provide one (1) soft copy of updated as-built drawings and 3 sets of prints.
  - .3 As-built drawings shall be submitted to the Consultant no later than 10 working days following the completion of the installation.
- .14 Warranty
- .1 The contractor shall provide a system warranty covering the installed cabling system against defects in workmanship, components, and performance, and follow-up support after project completion for a period of one year.
  - .2 The contractor shall warrant the cabling system against defects in workmanship for a period of one year from the date of system acceptance by the Board. The warranty shall cover all labour and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no additional cost to the owner.
  - .3 The performance warranty shall warrant properly installed 100 MHZ horizontal copper portion of the cabling system. Copper links shall be warranted against the link performance minimum expected results defined in the TIA/EIA 568A, and TSB-67.
  - .4 The contractor shall provide a guaranteed twenty four (24) hour response time to any warranty claims.
  - .5 The Communications Cabling Contractor will be required to provide a 25 year manufacturer's Extended Component Warranty and an Application Assurance Warranty for the entire communications cabling system. Warranty shall be in effect from the date of substantial completion as certified by the Architect.
  - .6 The Communications Cabling Contractor shall provide certification number within two weeks of award of the project.
  - .7 The Communications Cabling Contractor shall provide a letter of Certification within two weeks of substantial completion. This document will include the following:
    - .1 Verification of the performance of the installed system.
    - .2 Manufacturer's certification number.
    - .3 Identification of the installation by location and project number.
  - .8 The system manufacturer shall provide in writing to the owner that in the event of the demise or failure of the installing certified system installer, the manufacturer shall be responsible for providing another certified system installer/vendor to fulfill the remainder of the warranty conditions.

- .9 Contractors must ensure that the selected network cabling components manufacturer and the wiring manufacturer have contractual relationships to ensure that the system warranty is a true “end to end” structured cabling system warranty.
- .10 All costs for these warranties must be included in the tender amount.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CAN/ULC-S524 (latest edition), Installation of Fire Alarm Systems.
- .2 ULC-S525 (latest edition), Audible Signal Appliances for Fire Alarm Systems.
- .3 CAN/ULC-S526 (latest edition), Visual Signal Appliances, Fire Alarm.
- .4 CAN/ULC-S527 (latest edition), Control Units, Fire Alarm.
- .5 CAN/ULC-S528 (latest edition), Manual Pull Stations.
- .6 CAN/ULC-S529 (latest edition), Smoke Detectors.
- .7 CAN/ULC-S530 (latest edition), Heat Actuated Fire Detectors, Fire Alarm.
- .8 CAN/ULC-S536 (latest edition), Inspection and Testing of Fire Alarm Systems.
- .9 CAN/ULC-S537 (latest edition), Verification of Fire Alarm Systems.
- .10 CAN/ULC-S552 (latest edition), Inspection, Testing and Maintenance of Smoke Alarms.
- .11 OBC-2024, Ontario Building Code Compendium.

**1.2 DESCRIPTION OF SYSTEM**

- .1 System includes:
  - .1 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
  - .2 Trouble signal devices.
  - .3 Power supply facilities.
  - .4 Addressable manual alarm stations.
  - .5 Addressable and conventional automatic alarm initiating devices.
  - .6 Audible and visual signal devices.
  - .7 End-of-line devices.
  - .8 Annunciators.
  - .9 Ancillary devices.
  - .10 Interface and zone modules.
  - .11 Remote trouble indicator.

**1.3 REQUIREMENTS OF REGULATORY AGENCIES**

- .1 This system is subject to review by local building department officials, local fire department officials. **Therefore, submission of verification certificate and field technician device verification sheets is required prior to inspection by these officials. Schedule accordingly.**

#### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Electrical General Requirements Section.
- .2 Include:
  - .1 Layout of equipment.
  - .2 Zoning.
  - .3 Complete wiring diagram.

#### **1.5 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in Electrical General Requirements Section.
- .2 Include:
  - .1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.
  - .2 Technical data - illustrated parts lists with parts catalogue numbers.
  - .3 Copy of approved shop drawings.
  - .4 List of recommended spare parts for system.

#### **1.6 MAINTENANCE MATERIALS**

- .1 Include:
  - .1 10% spare glass rods for total number of manual pull box stations if applicable.

#### **1.7 TRAINING**

- .1 Arrange and pay for on-site demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system. **Obtain written receipt of training session and include in maintenance manual.**

#### **1.8 SYSTEM OPERATION**

- .1 The system shall be configured for single stage operation as outlined on the design drawings. Refer to Fire Alarm Sequence of Operation for specific fire alarm sequence functions which generally include the following:
  - .1 Activation of audible and visual signal devices.
  - .2 Cause alarm and supervisory zone of alarm device to be indicated on control panel and remote annunciator(s).
  - .3 Cause system trouble indications.
  - .4 Activate auxiliary functions.
  - .5 Transmit signal to fire department via monitoring station.
  - .6 Log the alarm in the historical alarm log file.
  - .7 System silence parameters.
  - .8 System reset parameters.

## **1.9 PERFORMANCE CRITERIA**

- .1 These specifications describe the minimum functional requirements for an electronically supervised, microprocessor based, fully integrated system. The initial installation shall include all the necessary electronic hardware, software and memory for a completely operable system in accordance with these specifications.

## **1.10 QUALITY ASSURANCE**

- .1 Each and all items of the fire alarm system shall be listed as the products of a single manufacturer under the appropriate category by the Underwriter's Laboratories of Canada and shall bear the "U.L.C." label.
- .2 Each and all items of the fire alarm system shall be covered by a one year parts and labour warranty covering defects resulting from faulty workmanship and materials. The warranty shall be deemed to begin on the date the system is accepted by the Project Manager on issuance of the substantial performance certificate for the project.
- .3 All control equipment must have Transient Protection Devices to comply with U.L.C. requirements.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 The fire alarm system shall be an addressable, single stage, zoned, non-coded, indicating, fully integrated fire alarm.
- .2 The fire alarm control panel shall allow for loading or editing of special instructions and operating sequences as required. The system shall be capable of on site programming to accommodate expansion, and changes required by local codes. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
- .3 The ability to selectively program input/output control functions based on ANDing, ORing, NOTing, Timing and Special Coded Operations is also to be incorporated in the resident software programming of the system.
- .4 The system shall have the ability to manually disable and enable any device/circuit individually for maintenance or testing purposes.
- .5 It shall be possible to reprogram selected or all smoke detector initiating zones for alarm verification.
- .6 It shall be possible to program an adjustable time delay circuit for each waterflow initiating circuit to prevent false alarms that may be caused by erroneous pressure surges in the sprinkler system.
- .7 All on site programming changes to the fire alarm system shall be password protected.

- .8 Wiring to any remote annunciator shall be supervised for open and ground conditions. A separate annunciator trouble indicator must be provided at the control panel, which shall illuminate and an audible trouble signal shall sound at the control panel upon the detection of an open or ground condition.
- .9 All Control Panels and Remote Annunciator Cabinets are to be properly grounded to building ground. Conduit ground will not be acceptable. The green coloured grounding loop shall be a minimum #14 AWG insulated copper conductor run in conduit. The ground loop shall be connected to building water supply to the line side of the water meter. Ground wire must not be run in the same conduit as the Fire Alarm wiring.

## **2.2 POWER REQUIREMENTS**

- .1 The control panels shall receive 120 VAC power via a dedicated overcurrent protected circuit. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green 'Power On' LED shall be displayed continuously while incoming power is present.
- .2 Control Panel output power supply shall have the following operating characteristics:
  - .1 Rated for five Amps continuous duty
  - .2 24 VDC filtered and regulated
  - .3 Power limited with a range of 20.4 VDC to 32 VDC.
  - .4 Automatic "Brownout" transfer to standby batteries when supply voltage falls to 102 VAC
- .3 The system shall be provided with sufficient standby capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of twenty-four hours with two hours of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
- .4 The system batteries shall be supervised so that a low battery condition or disconnection of the batteries shall be audibly and visually annunciated at the control panel.
- .5 Battery charger shall have the following operating characteristics:
  - .1 Ability to charge a range up to 33 AH to 70% of their capacity within 12 hours.
  - .2 Compatible with either lead acid or nicad batteries.
- .6 All circuits requiring system operating power shall be individually fused at the control panel.
- .7 The system shall be modular in design to allow future expansion with a minimum of hardware additions and system interruptions.

## **2.3 FIRE ALARM CONTROL PANEL**

- .1 The fire alarm control panel construction shall be modular in design with solid state microprocessor based electronics. An 80 character Liquid Crystal Display shall indicate alarms, supervisory service conditions and any troubles. The panel shall include but not be limited to the following:
  - .1 80 character LCD display
  - .2 Local Energy, Shunt Master Box, or Reverse Polarity Remote Station Connection
  - .3 Form C Trouble Contact
  - .4 Earth Ground Supervision Circuit
  - .5 Basic 8 A power supply
  - .6 Automatic Battery Charger
  - .7 Standby Batteries
  - .8 Resident non-volatile programmable operating system memory for all operating requirements.
  - .9 Five Programmable Multi-Function keys with status LED's
  - .10 Red Alarm LED and Acknowledge Button
  - .11 Yellow Supervisory Service LED and Acknowledge Button
  - .12 Yellow Trouble LED and Acknowledge Button
  - .13 Green Power on LED
  - .14 Alarm/Signal Silence Button
  - .15 System Reset Button
  - .16 Operator Interface Keypad for Manual Control and System Information Access
  - .17 Addressable Interface Control Card
  - .18 Supervised Annunciator Circuit
- .2 The control Panel shall be capable of chronologically logging and storing 300 events in an alarm log and 300 events in a trouble log. The historical logs shall be stored in the CPU's memory and shall be protected by a lithium battery that is supervised for a low battery condition. Each recorded event shall include the time and date of that event's occurrence. The alarm log file must be separate from the trouble log file. It shall be possible for the user to generate a report of both logs upon request.
- .3 All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.
- .4 Signal Circuits shall be independently supervised and fused such that a fault on one circuit shall not affect the operation of any of the other circuits. All signal circuits shall be configured as follows:
  - .1 Class "B" wiring, current limited.
  - .2 Rated at two Amps of continuous power.
  - .3 Capable of powering polarised 24 VDC audible and visual signalling appliances.

- .5 Provide dry contact auxiliary control circuits as follows:
  - .1 Central Station alarm output.
  - .2 Central Station trouble output.
  - .3 SPDT Form C relays fused at 2 A @ 24 VDC.
- .6 System Expansion Modules connected by ribbon cables shall be supervised for module placement. Should a module become disconnected the system trouble indicator must illuminate and audible trouble signal must sound.
- .7 The Fire Alarm Control Panel shall be capable of supporting RS-232-C I/O ports. CPU data output to the I/O ports shall be in a parallel ASCII format at field adjustable baud rates of 220, 300, 1200, 2400 and 4800.
- .8 A walk test feature must be provided.
- .9 All system controls shall be housed in a surface wall mounted steel cabinets. Finish shall be according to the manufacturer's standards.
- .10 All modules shall be secured behind hinged locked door with a full viewing tempered plastic window. The hinged locked doors shall give access to all the operating controls but shall not expose live connections.
- .11 All internal wiring, control circuits, connections and terminals shall only be accessible behind a removable metal retainer plate.
- .12 All Cabinets are to be properly grounded to building ground. Conduit ground will not be acceptable.
- .13 The system must provide communication with addressable initiating devices. All of these devices will be annunciated on the control panel's main LCD display. Annunciation shall include the following conditions for each point:
  - .1 40 Character Zone/Device Location
  - .2 Type of Device
  - .3 Detector Status (Normal/Alarm/Trouble)
  - .4 Device Missing/Failed
- .14 The communication format must be a completely digital poll/response protocol to allow tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- .15 Each addressable device must be uniquely identified by an address code entered on each device base at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact.
- .16 It shall be possible for the owner's representative to change a smoke detector without any special tools or programming.
- .17 The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions. Systems, which cannot support 100% of their point capacity in alarm simultaneously, cannot assure appropriate system response and are not acceptable.



- .18 **The appropriate quantity of isolator modules shall be installed so that a wiring fault (short, open or ground) within one floor area shall not prevent the normal operation of other addressable devices on other floor areas.**
- .19 The system shall maintain the sensitivity level set, for each sensor, over time by automatically compensating for environmental factors such as dust and dirt accumulations in a smoke sensor's chamber. The smoke sensor shall be a smoke density measuring device having no self-contained set-point. **The control panel shall determine the alarm decision for each sensor.**
- .20 The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value a 'Dirty Sensor' trouble condition shall be audibly and visually indicated at the control panel for the individual sensor.
- .21 All data transmissions, **including the analogue value**, between the smoke sensors and the control panel shall be digitally transmitted and incorporate parity and checksum digital data checks of each transmission.
- .22 An operator from the control panel, having a proper access level, shall have the ability to:
  - .1 Manually access and print the following information for each sensor in a report format that can be easily understood by the user:
    - .1 Primary Status
    - .2 Device Type
    - .3 Present Average Value
    - .4 Present Sensitivity Selected
    - .5 Highest Peak Detection Values
    - .6 Sensor Chamber Status (Normal, Almost Dirty, Dirty, Excessively Dirty)
  - .2 Manually control the following of each sensor:
    - .1 Clear Peak Detection Values
    - .2 Enable or Disable the Point
    - .3 Clear Verification Tally
    - .4 Control a Sensor's Relay Driver Output
- .23 It shall be possible to program the control panel to **automatically** change the sensitivity settings of each sensor based on **time-of-day** and **day-of-week**.

## 2.4 ADDRESSABLE MANUAL ALARM STATIONS

- .1 Manual alarm stations shall be addressable, single action, non-coded, semi-flush mounted type. Pull stations shall be break-glass style. Contacts are to activate when the handle is pulled down.
- .2 Addressable pull station electronics shall be mounted to the back plate of the station. The station's address will be set at the time of installation. Device addressing shall be accomplished by either an electrical or mechanical means.
- .3 Where noted on drawings, stations are to be equipped with tamperproof guard equal to Stopper II Cat. # STI-1100.

## **2.5 INTELLIGENT DETECTORS-GENERAL OPERATION**

- .1 Addressable devices shall use simple to install and maintain decade, numbered 0 to 9, address switches. Detectors that have expanded addressing will have decade switch numbered from 0 to 15 for the most significant digit to allow detector addressing from 1 to 250.
- .2 Device addressing shall be accomplished by either an electrical or mechanical means.
- .3 Detectors shall be intelligent (analog) and addressable and shall connect with two wires to the fire alarm control panel signalling line circuits.
- .4 Addressable smoke detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
- .5 The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
- .6 Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance.
- .7 The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
- .8 The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
- .9 Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (PHOTO, THERMAL).
- .10 Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
- .11 Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
- .12 Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.

- .13 The sensors shall be of a low profile design and ULC listed for both ceiling and wall mount applications.
- .14 Automatic smoke sensors shall be equipped with a dust cover, which shall be removed at the time of verification to prevent dust and dirt entering the smoke chamber during construction.
- .15 A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

## **2.6 INTELLIGENT MULTI-DETECTOR**

- .1 The intelligent multi-detector shall be an addressable device, which is designed to monitor photoelectric, ionization, and thermal technologies in a single sensing device. This detector shall utilize advanced electronics which react to smaller products of combustion found in fast flaming fires (ionization), slow smouldering fires (photoelectric), and heat (thermal) all within a single sensing device.
- .2 The multi-detector shall include two bicolor LEDs, which flash green in normal operation and turn on steady red in alarm.
- .3 Detectors are to be provided with relay base where noted on the drawings.
- .4 Separately mounted photoelectric ionization and heat detectors in the same location are not acceptable alternatives.

## **2.7 FIXED TEMPERATURE HEAT DETECTOR**

- .1 These heat detectors shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the/ time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. The heat detector shall have a nominal alarm point rating of 57°C (135°F). The heat detector shall be rated for ceiling installation at a minimum of 21.3 m (70') centres and be suitable for wall mount applications.

## **2.8 FIXED TEMPERATURE / RATE OF RISE HEAT DETECTOR**

- .1 These heat detectors shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm, The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 57°C (135°F) and a rate-of-rise alarm point of 9°C (15°F) per minute. The heat detector shall be rated for ceiling installation at a minimum of 21.3 m (70') centres and be suitable for wall mount applications.

## **2.9 PHOTOELECTRIC SMOKE DETECTOR**

- .1 The intelligent photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging, and humidity. The photo detector shall be rated for ceiling installation at a minimum of Soft (Olin) centres and be suitable for wall mount applications.
- .2 The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:
  - .1 Temperature: 0°C to 49°C (32°F to 120°F)
  - .2 Humidity: 0-93% RH, non-condensing
  - .3 Elevation: no limit
- .3 Detectors are to be provided with relay base where noted on the drawings.

## **2.10 STANDARD DETECTOR MOUNTING BASES**

- .1 Provide standard detector mounting bases suitable for mounting on North American 1-gang, 85 mm (3 ½ ") or 100 mm (4") octagon box and 100 mm (4") square box. The base shall, contain no electronics, support all detector types and have the following minimum requirements:
  - .1 Removal of the respective detector shall not affect communications with other detectors.
  - .2 Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.

## **2.11 AUDIBLE/VISUAL SIGNAL DEVICES**

- .1 Horn: flush mounted temporal horn, 24Vdc operation, 94 dBA rating at 3 m (10'), white finish, FM and ULC listed.
- .2 Mini Horns: flush mounted temporal mini horn, 24Vdc operation, selectable HIGH/LOW setting 94.5 dBA (high)/89.8 dBA (low) at 3 m (10'), white coverplate, FM and ULC listed. Suitable for mounting on a single gang box.
- .3 Strobe: semi-recessed, 24Vdc operation, complete with selectable 15/30/75/110 candela output (unless otherwise noted set at 75 cd), synchronized strobe, white finish, FM and ULC listed. Suitable for mounting on a single gang box.

- .4 Mini Horn/Strobe: flush mounted temporal combination mini horn/strobe, 24 Vdc operation, selectable HIGH/LOW setting 94.5 dBA (high)/89.8 dBA (low) at 3 m (10') selectable 15/30/75/110 candela output (unless otherwise noted set at 75 cd), synchronized strobe white coverplate, FM and ULC listed. Suitable for mounting on a single gang box.

**NOTES:**

- .1 **Any surface mounted signal devices must be provided with suitable backboxes supplied by the manufacturer.**
- .2 **Provide synchronization modules to suit signal devices (if required by manufacturer).**

**2.12 END OF LINE RESISTORS**

- .1 End-of-line resistors for signalling circuits shall be sized to ensure the correct supervisory current flows in each circuit.
- .2 End-of-line resistors shall be mounted on a stainless steel plate for mounting on a standard single gang box and bear the ULC label.

**2.13 REMOTE ANNUNCIATOR PANELS**

- .1 Each remote panel in the installed system shall include remote control display annunciators. These annunciators shall have integral membrane style, tactile push-button control switches for the control of system functions, and LED-s with programmable (software-controlled) flash rates and slide-in labels for annunciation of system events.
- .2 The remote control display annunciators shall provide the system with individual zone and device annunciation.
- .3 Annunciator must be keyed similar to control panel.

**2.14 GRAPHIC DISPLAY (PASSIVE)**

- .1 Black and white layout of facility showing all zones as specified/indicated.
- .2 Display is to be found behind Plexiglas, approximate size: 500 mm x 500 mm (20" x 20").
- .3 Finish frame to architects direction.

**2.15 INTELLIGENT MODULES – GENERAL OPERATION**

- .1 The modules shall have a minimum of 2 diagnostic LED's mounted behind a finished coverplate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:
  - .1 Temperature: 0°C to 49°C (32°F to 120°F).
  - .2 Humidity: 0-93% RH, non-condensing.

## **2.16 MONITOR MODULE**

- .1 The monitor modules shall have the following operating characteristics:  
  
A flashing LED indicates that the module is in communication with the control panel.  
The LED latches steady on alarm (subject to current limitations on the loop).
- .2 The monitor modules shall have the following features:  
  
Nominal operating voltage: 15 to 32 VDC.  
Maximum current draw: 5.1 mA (LED on)  
Average operating current: 400 uA (LED flashing)  
EOL resistance: 47K ohms.  
Temperature range: 0°C to 49°C (32°F to 120°F)  
Humidity range: 10% to 93% noncondensing  
Dimensions: 114.3mm (4.5") high x 101.6 mm (4") wide x 31.75 mm (1.25") deep. Mounts to a 101.6 mm (4") square x 53.975 mm (2.1/8") deep box.

## **2.17 ISOLATOR MODULE**

- .1 Fault isolator modules shall be provide to automatically isolate wire-to-wire short circuits on an SLC loop. The fault isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop. If a wire-to wire short occurs, the fault isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the fault isolator module shall automatically reconnect the isolated section of the SLC loop. The fault isolator module shall not require any address-setting, and its' operations shall be totally automatic. It shall not be necessary to replace or reset a fault isolator module after its normal operation. The fault isolator module shall mount in a standard 10.16 cm (4") deep electrical box, in a surface-mounted backbox, or in the fire alarm control panel. It shall provide a single LED which shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

## **2.18 CONTROL MODULE**

- .1 Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.
- .2 The control module NACs may be wired for Style Z or Style Y (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% or all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
- .3 The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 Amps at 30 VDC.

## 2.19 SPRINKLER AND SUPERVISED VALVE CONNECTIONS

- .1 Sprinkler and standpipe system contacts shall be provided by the mechanical/sprinkler contractor but connected into the fire alarm system by this Division.

## 2.20 SYSTEM WIRING

- .1 The system wiring must be FSA rated in conformance with the Electrical Safety Code to suit the type of installation.
- .2 Wiring shall be minimum #18 AWG twisted shielded pair in conduit. "Securex 2" armoured cable will be permitted to be used for "drops" to devices on accessible ceilings.
- .3 As indicated on system riser diagram initiating device wiring shall be run in a loop with a home run from the last device to the control panel (Class 'A' configuration). Wiring from the "loop" module to conventional devices must be supervised, run in conduit, and conform to the standards of the Electrical Safety Code.
- .4 Signal wiring is to be cross connected in a class 'B' configuration.
- .5 Install isolator modules and end of line resistors in service rooms no higher than 2.4 M AFF. Provide location of these devices at the time of shop drawing submission.
- .6 **These are the basic wiring requirements for system operation. Prior to tender close manufacturer and contractor are to confirm all necessary wiring specifications and requirements.**

## 2.21 APPROVED EQUIPMENT

<u>DEVICE</u>	<u>NOTIFIER</u>	<u>EDWARDS</u>	<u>SIMPLEX</u>	<u>MIRCOM</u>
<u>Control Panel</u>				
	NFS2-3030 1-10 loops 318 add/loop	EST 4 or EST 3X	4010-ES -2 loop -250 add	FX-4000 Series
<u>Intelligent Devices</u>				
Addressable Multi-Sensor	FSP-851TA	SIGA2-PS		MIX-2251TB
Addressable Base	B710LPA	SIGA-SB	4098-9792	B210LPA

Addressable Base c/w Relay	B224RBA	SIGA-RB	4098-9791 c/w 2098-9737	B224RBA
Heat Sensor	FST-851RA	SIGA2-HRS or SIGA2-HFS	4098-9733	MIX-5251RBA Series
Smoke Detectors	FSI-851A	SIGA-PS	4098-9714	MIX-2251BA
Monitor Module	FMM-1A	SIGA-CT Series	ZAM-Monitor 4090-9001	MIX-M500MA
Control Module	FCM-1 or FRM-1	SIGA-CR	ZAM-Control 4090-9002	MIX-M500RA
Isolator Module	ISO-XA	SIGA-IM	4090-9116	M500XA
Annunciator	ACM-32 AEM-32 ACM-32AY	EST3-6ANN	4603-9101 (GEO-7000 Series flush enclosure)	RAX-LCD RAM-1032TZ/RAM-1016TZ RAX-1048
<b><u>Conventional and Auxiliary Devices</u></b>				
Horn (white)	Spectralert Series	757 Series	True Alert Series	FH-340
Mini Horn (white)	MHRA (System Sensor)	Genesis G1R-HD	4901-9858	FH-340R
Mini Horn complete with strobe (white)	P2RA (System Sensor)	Genesis G1R-HDVM	4906-9127	FHS-340R
Strobe (white)	SRA (System Sensor)	G1R-VM	4906-9101	FS-340R



**Part 3 Execution**

**3.1 INSTALLATION**

- .1 The entire system shall be installed in accordance with CAN/ULC-S524 (latest edition) and approved manufacturers manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation, All wiring shall be of the type recommended by the Electrical Safety Code, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.
- .2 Install main control panel and connect to ac power supply.
- .3 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .4 Locate and install detectors and connect to alarm circuit wiring. **Do not mount detectors within 1 m (39") of air outlets.** Maintain at least 600 mm (24") radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .5 Connect alarm circuits to main control panel.
- .6 Locate and install signal devices and connect to signalling circuits.
- .7 Connect signalling circuits to main control panel.
- .8 Install end-of-line devices at end of applicable alarm and signalling circuits.
- .9 Install remote annunciator panels and connect to annunciator circuit wiring.
- .10 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .11 Connect fire suppression systems to control panel.
- .12 **Connect each combination fire/smoke damper integral detector outputs to individual monitor modules for alarm condition and for AC power to damper assembly trouble condition at the fire alarm panel based on module address.**

**3.2 PROTECTION**

- .1 Contractor is to ensure all fire protection system detectors are protected from dust, dirt, humidity, and water at all times during construction. This applies to detectors installed, stored on site or stored in storage containers. Any detectors that are damaged or dirty shall be replaced at the contractor's expense.

**3.3 FIELD QUALITY CONTROL**

- .1 The system shall be installed and fully tested under the supervision of trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.

**3.4 ACCEPTABLE INSTALLER**

- .1 The fire alarm / life safety system specified herein shall be installed by an Authorized Electrical Contractor who is CFAA certified.

### **3.5 EXAMINATION**

- .1 Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm / Life Safety System and all associated components are to be installed shall be made.
- .2 Any of these area(s) which are found to be outside the manufacturers' recommended environments for the particular specified products shall be noted on a Site Examination Report which shall be given to the Building Owners Representative, and the Consultant.
- .3 Any shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

### **3.6 DEMONSTRATION**

- .1 Each of the intended operations of the installed Fire Alarm / Life Safety System shall be demonstrated to the Building Owners' Representative and the Consultant.

### **3.7 SYSTEM TEST**

- .1 Perform tests in accordance with General Electrical Requirements Section and CAN/ULC-S537- (latest edition) Standard for the Verification of Fire Alarm Systems.
- .2 Fire alarm system:
  - .1 Test each device and alarm circuit to ensure noted devices transmit alarm to control panel and actuate general alarm and ancillary devices.
  - .2 Check annunciator panels to ensure zones are shown correctly.
  - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
  - .4 Class A circuits.
    - .1 Test each conductor on all circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
    - .2 Test each conductor on all circuits for capability of providing alarm signals during ground-fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
  - .5 Class B circuits
    - .1 Test each conductor on all circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
- .3 The control panel shall continuously perform as automatic self-test routine on each sensor, which will functionally check the sensor electronics and ensure the accuracy of the valves being transmitted to the control panel.
- .4 Automatic testing will occur at a rate of one sensor every four minutes.

- .5 The sensor's average analogue value is the average of the last 2000 recorded analogue entries of its chamber.
- .6 Any sensor that fails this test shall indicate a '**SELF-TEST ABNORMAL**' trouble condition with the sensor's address at the control panel.
- .7 The system shall automatically indicate when an individual sensor needs cleaning. When the sensor's average value reaches a predetermined value, a '**DIRTY SENSOR**' trouble condition shall be audibly and visually indicated at the local control panel for that sensor. If a '**DIRTY SENSOR**' indication is left unattended and its average value increases to a second predetermined value, an '**EXCESSIVELY DIRTY SENSOR**' trouble condition shall be indicated at the local control panel for that sensor. To prevent false alarms, these '**DIRTY**' conditions shall in no way decrease the amount of smoke obscuration necessary to generate an alarm condition.
- .8 An operator having a proper access level, shall have the capability to manually access the following information from the control panel:
  - .1 Primary Status
  - .2 Device Type
  - .3 Present Average Value
  - .4 Present Sensitivity Selected\*
  - .5 Highest Peak Detection Values (HVP)\*
  - .6 Sensor Range (Normal, Dirty, Excessively Dirty)\* Values shall be in 'percent of smoke obscuration' format so that no interpretation is required by the operator.

### 3.8 AUDIBILITY TESTING

- .1 Audibility Testing:
  - .1 The contractor is to coordinate an audibility test prior to occupancy of the facility. The test is to be performed by the representatives of the fire alarm manufacturer in the presence of the consultant. The test report is to be in chart form indicating:
    - .1 Project
    - .2 Date of test
    - .3 Room name and number
    - .4 Ambient dB level
    - .5 Alarm dB level
    - .6 Name of testing technician
  - .2 The test results are to be submitted to the consultant for review prior to issuing to owner's representatives and/or authorities having jurisdiction.

### 3.9 INTEGRATED LIFE SAFETY SYSTEM TESTING

- .1 This electrical contractor shall participate in integrated testing of this life safety system in conformance with Electrical General Requirements. Include all associated costs in tender.

**3.10            ADDITIONAL INSTALLED FIRE ALARM SYSTEM COMPONENTS**

- .1        The electrical contractor is to include in their bid the cost to add five (5) additional signaling devices to be installed and verified in locations as directed by the consultant. Note: This installation and verification and subsequent audibility test will be occurring after the initial audibility testing is complete.
- .2        The electrical contractor is to include in their bid the cost to add three (3) additional fire detection devices (heat or smoke detectors) to be installed and verified in locations as directed by the consultant.
- .3        The electrical contractor is to include in their bid the cost to add one (1) additional fire alarm zone with associated zone modules and including six (6) additional isolation modules to be installed and verified as directed by the consultant.
- .4        The electrical contractor is to include in their bid the cost to add three (3) additional fire smoke damper connections and 120V loss of power trouble signal with associated module and including ten (10) additional isolation modules to be installed and verified as directed by the consultant.

**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/m<sup>3</sup> 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

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- 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:  
          150 mm of topsoil for sodded areas  
          600 mm of topsoil for planting beds
  - .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

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- 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 Bike racks supplied by Maglin 1-800-716-5506  
Model No. MBR-0500-00003  
Finish: Black Powder Coat  
Surface Mount  
Install as per manufacturer's Specifications
    - .2 U-Cara Seat Wall by Unilock (1-800-265-6124) or Approved Equal  
Colour: Midnight Sky  
Coping: Umbriano Coping  
Coping Colour: Midnight Sky  
Height: 533mm
    - .3 River pebble to be installed as per detail 3 on L2
- 3 Execution
  - 3.1 **INSTALLATION**
    - .1 Install as per the details identified on drawings L2.
    - .2 Prior to installation provide layout to the approval of the landscape architect.

END OF SECTION

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- 1 General
    - 1.1 **RELATED WORK**
      - .1 Section 31 22 19.13 Topsoil & Finish Grading
    - 1.2 **SOURCE QUALITY CONTROL**
      - .1 Obtain approval from Landscape Architect of sod at source.
      - .2 When proposed source of sod is approved, use no other source without written authorization.
    - 1.3 **SCHEDULING**
      - .1 Schedule sod laying to coincide with topsoil operations.
    - 1.4 **MEASUREMENT FOR PAYMENT**
      - .1 Nursery sod will be measured in square metres and paid for under item "Sod".
      - .2 Access areas and work zones with high erosion potential will require protection in the form of pegged sod.
  - 2 Products
    - 2.1 **MATERIALS**
      - .1 Nursery sod: Quality and source to comply with standards outlined in "Guide Specification for Nursery Stock", Section 17, 9th edition, published by Canadian Nursery Trades Association.
      - .2 Number one Kentucky Bluegrass/Fescue Sod: sod grown from maximum 40% Kentucky Bluegrass, 30% creeping Red Fescue, supplied by Greenhorizons, 519-653-7494 or approved equivalent.
      - .3 Broken, dry, discoloured pieces will be rejected by Landscape Architect.
      - .4 Wooden pegs 17 x 17 x 200 x 200 mm.
      - .5 Water: potable.
      - .6 Fertilizer: complete synthetic slow release fertilizer with maximum 35% water Soluble nitrogen. Formulation ratio: 21-7-7 with slow release nitrogen at 3lbs per 1000 sq feet.
  - 3 Execution
    - 3.1 **LAYING OF SOD**
      - .1 Prior to sodding, obtain approval from Landscape Architect that finished grade and depth of topsoil are satisfactory.
      - .2 Lay sod within 24 hr. of being lifted.
      - .3 Sodding during excessively wet conditions, at freezing temperatures or over frozen soil is not acceptable.
      - .4 Lay sod in rows, perpendicular to slope, and with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
      - .5 Provide close contact between sod and soil with light rolling. Use of heavy roller to correct irregularities in grade is not permitted.
      - .6 Water sod immediately after laying to obtain moisture penetration to top 100 mm of topsoil.
    - 3.3 **MAINTENANCE**
-



- .1 Maintain sodded area from start of installation until final acceptance is awarded from the Landscape Architect for all landscape project items unless otherwise directed by the Landscape Architect.
- .2 Water sodded areas in sufficient quantities and at frequency required to maintain soil under sod continuously moist to depth of 75 mm to 100 mm. This is assumed, at a minimum, to be twice a week for the 4 weeks following installation, and once every two weeks thereafter from June through to September.
- .3 Maintain sodded areas weed free.
- .4 Fertilize sodded areas two weeks after sodding with .2.11 ratio fertilizer. Spread evenly at rate of 1 kg. of nitrogen/100m<sup>2</sup> and water in well.

3.4

**ACCEPTANCE**

- 1. Sodded areas will be accepted at final inspection by Landscape Architect provided that:
  - .1 Sodded areas are properly established.
  - .2 Sod is free of bare and dead spots and without weeds.
  - .3 No surface soil is visible when grass has been cut to height of 40 mm.
  - .4 Sodded areas have been cut minimum 2 times.
  - .5 Sodded areas have been fertilized.  
(Landscape Architect is to be notified 24 hrs in advance by the contractor of when the fertilizer application is to be applied.)
  - .6 Schedule sod installation so final acceptance is a minimum of 1 week before date of substantial performance.

END OF SECTION

1 General

1.1 **RELATED WORK**

- .1 Section 31 22 19.13 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
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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 replaced 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-leafed 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
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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<sup>2</sup>. 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.
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- .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

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