Request for Quotations

For

General Contractor for Animal Shelter Construction

Request for Quotations No.: **2024-113**

Issued: **October 3, 2024**

Submission Deadline: **October 31, 2024 at 3:00 PM local time**

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PART 1 – INVITATION AND SUBMISSION INSTRUCTIONS

1.1 Invitation to Respondents

This Request for Quotations (the "RFQ") is an invitation by the City of Brantford (the "City") to prospective respondents to submit non-binding quotations for the Construction of the Brantford Animal Shelter, to be located at 10 Kraemer's Way, as further described in Section A of the RFQ Particulars (Appendix B) (the "Deliverables").

1.2 City's Procurement Policy

The City's procurement processes are governed by the City's Purchasing Policy Bylaw 34-2020 (the "City's Policy"). It is the respondent's responsibility to become familiar with and comply with the City's Policy, which is available online at:

https://www.brantford.ca/en/business-and-development/bids-and-tenders.aspx

1.3 RFQ Contact

For the purposes of this procurement process, the "RFQ Contact" will be:

Eva Cislo, Coordinator of Purchasing
Email: evacislo@brantford.ca

Respondents and their representatives are not permitted to contact any employees, officers, agents, elected or appointed officials or other representatives of the City, other than the RFQ Contact, concerning matters regarding this RFQ. Failure to adhere to this rule may result in the disqualification of the respondent and the rejection of the respondent's quotation.

1.4 Type of Contract for Deliverables

The selected respondent will be requested to enter into a contract for the provision of the Deliverables on the terms and conditions set out in the Form of Agreement (Appendix A) (the "Agreement"). It is the City's intention to enter into a contract with only one legal entity.

1.5 RFQ Timetable

Issue Date of RFQ	**October 3, 2024**
Site Visit	**N/A**
Deadline for Questions	**October 23, 2024 at 3:00 PM local time**
Deadline for Issuing Addenda	**October 28, 2024**
Submission Deadline	**October 31, 2024 at 3:00 PM local time**
Rectification Period	2 business days
Anticipated Execution of Agreement	**November 2024**

The RFQ timetable is tentative only, and may be changed by the City at any time. For greater clarity, business days means all days that the City is open for business.

1.6 Submission of Quotations

1.6.1 Electronic Quotation Submission

The City shall only accept and receive electronic quotation submissions through the City's electronic bidding system at: bids.brantford.ca (the "Bidding System").

All respondents must establish a Bidding System vendor account and be registered as a Plan Taker for the procurement opportunity, which will enable the respondent to download the RFQ documents, to receive addenda email notifications, download addenda and to submit their quotation electronically through the Bidding System.

HARD COPY QUOTATION SUBMISSIONS WILL **NOT** BE ACCEPTED.

1.6.2 Multiple or Alternate Bids

Unless otherwise provided for in this RFQ, the City will not accept multiple quotations or alternate quotations from a respondent. The submission of multiple quotations by a respondent may result in the rejection of all of the quotations submitted by that respondent.

1.6.3 Addendum

Any addenda issued by the RFQ Contact shall form part of the bid documents. Respondents must acknowledge receipt of any addenda when submitting their quotation through the Bidding System. Respondents must check a box for each addendum and any applicable attachments that have been issued before a respondent can submit their quotation submission online.

Questions or additional information requested from the RFQ Contact must be submitted in accordance with section 3.2.1. Addendum will typically be issued through the Bidding System, forty-eight (48) hours prior to the Submission Deadline.

To ensure all addenda have been acknowledged, the City encourages respondents not to submit their quotation prior to forty-eight (48) hours before the Submission Deadline. If a respondent submits their quotation and an addendum is issued by the City, the Bidding System

shall **WITHDRAW** their quotation submission and change their quotation submission to an **INCOMPLETE STATUS** (not accepted by the City). The withdrawn bid can be viewed by the respondent in the "**MY BIDS**" section of the Bidding System. The respondent is solely responsible to:

i) review the status of their bid;
ii) make any required adjustments to their quotation;
iii) acknowledge the addendum; and
iv) ensure the re-submitted quotation is RECEIVED by the Bidding System by no later than the Submission Deadline.

1.6.4 Withdrawal or Amendment of Quotations

Quotations are non-binding and may be withdrawn at any time prior to entering into a contract for the provision of the Deliverables. Respondents may withdraw their submission prior to the Submission Deadline through the Bidding System. To withdraw a submission after the Submission Deadline, a notice of withdrawal must be sent to the RFQ Contact and must be signed by an authorized representative of the respondent. The City will not accept amendments to submitted quotations. If a respondent wishes to amend an already submitted quotation prior to the Submission Deadline, the respondent may withdraw the existing quotation and submit a revised quotation prior to the Submission Deadline through the Bidding System. The respondent is solely responsible to ensure the re-submitted quotation is **RECEIVED** by the Bidding System by no later than the Submission Deadline.

1.6.5 Submission Deadline

The closing time shall be determined by the Bidding System web clock.

Respondents are cautioned that the timing of a quotation submission is based on when the quotation is **RECEIVED** by the Bidding System, **not** when a bid is submitted by a respondent, as bid transmission can be delayed in an internet bottleneck due to file transfer size, transmission speed, etc.

[End of Part 1]

PART 2 – EVALUATION AND AWARD

2.1 Stages of Evaluation

The City will conduct the evaluation of quotations in the following stages:

2.2 Stage I – Mandatory Submission Requirements

Stage I will consist of a review to determine which quotations comply with all of the mandatory submission requirements. If a quotation fails to satisfy all of the mandatory submission requirements, the City will issue the respondent a rectification notice identifying the deficiencies and providing the respondent an opportunity to rectify the deficiencies. If the respondent fails to satisfy the mandatory submission requirements within the Rectification Period, its quotation will be excluded from further consideration. The Rectification Period will begin to run from the date and time that the City issues a rectification notice to the respondent. The mandatory submission requirements are listed in Section C of the RFQ Particulars (Appendix B).

2.3 Stage II – Mandatory Technical Requirements

The City will review the quotations to determine whether the mandatory technical requirements as set out in Section D of the RFQ Particulars (Appendix B) have been met. Questions or queries on the part of the City as to whether a quotation has met the mandatory technical requirements will be subject to the verification and clarification process set out in Part 3.

2.4 Stage III – Pricing

Stage III will consist of an evaluation of the submitted pricing in each qualified quotation in accordance with the price evaluation method set out in the Pricing Form. The evaluation of price will be undertaken after the evaluation of mandatory requirements has been completed.

2.5 Selection of Top-Ranked Respondent

After the completion of Stage III, compliant respondents will be ranked based on the price evaluation. Subject to the process rules contained in the Terms and Conditions of the RFQ Process (Part 3), the top-ranked respondent will be invited to enter into the Agreement in accordance with Part 3. In the event of a tie, the tie will be broken in accordance with the City's Policy. The selected respondent will be notified in writing and will be expected to satisfy any applicable conditions of this RFQ, including the pre-conditions of award listed in Section E of the RFQ Particulars (Appendix B) within 10 days, and enter into the Agreement within 30 days, of the date of the notice of selection. Failure to do so may result in the disqualification of the respondent and the selection of another respondent or the cancellation of the RFQ.

[End of Part 2]

PART 3 – TERMS AND CONDITIONS OF THE RFQ PROCESS

3.1 General Information and Instructions

3.1.1 Respondents to Follow Instructions

Respondents should structure their quotations in accordance with the instructions in this RFQ. Where information is requested in this RFQ, any response made in a quotation should reference the applicable section numbers of this RFQ.

3.1.2 Quotations in English

All quotations are to be in English only.

3.1.3 No Incorporation by Reference

The entire content of the respondent's quotation should be submitted in a fixed form, and the content of websites or other external documents referred to in the respondent's quotation but not attached will not be considered to form part of its quotation.

3.1.4 References and Past Performance

In the evaluation process, the City may include information provided by the respondent's references and may also consider the respondent's past performance or conduct on previous contracts with the City or other institutions. The City may disqualify a respondent on the basis of information regarding the respondent's past performance or conduct that the City finds unsatisfactory or unacceptable regardless of the respondent's fee.

3.1.5 Information in RFQ Only an Estimate

The City and its advisers make no representation, warranty or guarantee as to the accuracy of the information contained in this RFQ or issued by way of addenda. Any quantities shown or data contained in this RFQ or provided by way of addenda are estimates only, and are for the sole purpose of indicating to respondents the general scale and scope of the Deliverables. It is the respondent's responsibility to obtain all the information necessary to prepare a quotation in response to this RFQ.

3.1.6 Respondents to Bear Their Own Costs

The respondent will bear all costs associated with or incurred in the preparation and presentation of its quotation, including, if applicable, costs incurred for interviews or demonstrations.

3.1.7 Quotation to be Retained by the City

The City will not return the quotation or any accompanying documentation submitted by a respondent.

3.1.8 No Guarantee of Volume of Work or Exclusivity of Contract

The City makes no guarantee of the value or volume of work to be assigned to the successful respondent. The contract with the selected respondent will not be an exclusive contract for the provision of the described Deliverables. The City may contract with others for goods and services the same as or similar to the Deliverables or may obtain such goods and services internally.

3.2 Communication after Issuance of RFQ

3.2.1 Respondents to Review RFQ

Respondents should promptly examine all of the documents comprising this RFQ, and may direct questions or seek additional information in writing through the Bidding System by using the **SUBMIT A QUESTION** button, on or before the Deadline for Questions.

All questions or comments submitted by respondents will be deemed to be received once the email has entered into the Bidding System's email inbox. No such communications are to be directed to anyone other than the RFQ Contact. The City is under no obligation to provide additional information, and the City is not responsible for any information provided by or obtained from any source other than the RFQ Contact. It is the responsibility of the respondent to seek clarification from the RFQ Contact on any matter it considers to be unclear. The City is not responsible for any misunderstanding on the part of the respondent concerning this RFQ or its process.

Where a named manufacturer, product, 'or approved equivalent' appears in the specification, and an equivalent product is anticipated to meet or exceed the requested product, it is the responsibility of the respondent to submit a question in writing to the RFQ Contact through the Bidding System prior to the Deadline for Questions requesting the approved equivalent be considered. The respondent should be prepared to provide supporting documentation to state the details of the equivalent offered and demonstrate equivalence to the satisfaction of the City. Should the requested approved equivalent be deemed acceptable, in the sole discretion of the City, an addendum will be issued to inform all plan takers of the approved equivalent.

3.2.2 All New Information to Respondents by Way of Addenda

This RFQ may be amended only by addendum in accordance with this section. If the City, for any reason, determines that it is necessary to provide additional information relating to this RFQ, such information will be communicated to all respondents by addendum. Each addendum forms an integral part of this RFQ and may contain important information, including significant changes to this RFQ. Respondents are responsible for obtaining all addenda issued by the City.

3.2.3 Post-Deadline Addenda and Extension of Submission Deadline

If the City determines that it is necessary to issue an addendum after the Deadline for Issuing Addenda, the City may extend the Submission Deadline for a reasonable period of time.

3.2.4 Verify, Clarify and Supplement

When evaluating quotations, the City may request further information from the respondent or third parties in order to verify, clarify or supplement the information provided in the respondent's

quotation, including but not limited to clarification with respect to whether a quotation meets the mandatory technical requirements set out in Section D of the RFQ Particulars (Appendix B). The City may revisit, re-evaluate and rescore the respondent's response or ranking on the basis of any such information.

3.3 Notification and Debriefing

3.3.1 Notification to Other Respondents

Once an agreement is executed by the City and a respondent, the other respondents will be notified by public posting of the outcome of the RFQ process on the City's website.

3.3.2 Debriefing

Respondents may request a debriefing after receipt of a notification of the outcome of the procurement process. All requests must be in writing to the RFQ Contact and must be made within sixty (60) days of such notification.

3.3.3 Procurement Protest Procedure

If a respondent wishes to challenge the RFQ process, it should provide written notice to the RFQ Contact in accordance with the dispute resolution process set out in the City's Policy and any applicable trade agreement or other applicable bid protest procedures. The notice must provide a detailed explanation of the respondent's concerns with the procurement process or its outcome.

3.4 Conflict of Interest and Prohibited Conduct

3.4.1 Conflict of Interest

For the purposes of this RFQ, the term "Conflict of Interest" includes, but is not limited to, any situation or circumstance where:

(a) in relation to the RFQ process, the respondent has an unfair advantage or engages in conduct, directly or indirectly, that may give it an unfair advantage, including but not limited to (i) having, or having access to, confidential information of the City in the preparation of its quotation that is not available to other respondents, (ii) communicating with any person with a view to influencing preferred treatment in the RFQ process (including but not limited to the lobbying of decision makers involved in the RFQ process), or (iii) engaging in conduct that compromises, or could be seen to compromise, the integrity of the open and competitive RFQ process or render that process non-competitive or unfair; or

(b) in relation to the performance of its contractual obligations under a contract for the Deliverables, the respondent's other commitments, relationships or financial interests (i) could, or could be seen to, exercise an improper influence over the objective, unbiased and impartial exercise of its independent judgement, or (ii) could, or could be seen to, compromise, impair or be incompatible with the effective performance of its contractual obligations.

3.4.2 Disqualification for Conflict of Interest

The City may disqualify a respondent for any conduct, situation or circumstances, determined by the City, in its sole and absolute discretion, to constitute a Conflict of Interest as defined above.

3.4.3 Disqualification for Prohibited Conduct

The City may disqualify a respondent, rescind notice of selection or terminate a contract subsequently entered into if the City determines that the respondent has engaged in any conduct prohibited by this RFQ.

3.4.4 Prohibited Respondent Communications

Respondents must not engage in any communications that could constitute a Conflict of Interest and should take note of the Conflict of Interest declaration set out in the Submission Form.

3.4.5 Respondent Not to Communicate with Media

Respondents must not at any time directly or indirectly communicate with the media in relation to this RFQ or any agreement entered into pursuant to this RFQ without first obtaining the written permission of the RFQ Contact.

3.4.6 No Lobbying

Respondents must not, in relation to this RFQ or the evaluation and selection process, engage directly or indirectly in any form of political or other lobbying whatsoever to influence the selection of the successful respondent(s).

3.4.7 Illegal or Unethical Conduct

Respondents must not engage in any illegal business practices, including activities such as bid-rigging, price-fixing, bribery, fraud, coercion or collusion. Respondents must not engage in any unethical conduct, including lobbying, as described above, or other inappropriate communications; offering gifts to any employees, officers, agents, elected or appointed officials or other representatives of the City; deceitfulness; submitting quotations containing misrepresentations or other misleading or inaccurate information; or any other conduct that compromises or may be seen to compromise the competitive process provided for in this RFQ.

3.4.8 Past Performance or Past Conduct

The City may prohibit a supplier from participating in a procurement process based on past performance or based on inappropriate conduct in a prior procurement process, including but not limited to the following:

(a) illegal or unethical conduct as described above;

(b) the refusal of the supplier to honour its submitted pricing or other commitments; or

(c) any conduct, situation or circumstance determined by the City, in its sole and absolute discretion, to have constituted an undisclosed Conflict of Interest.

3.5 Confidential Information

3.5.1 Confidential Information of the City

All information provided by or obtained from the City in any form in connection with this RFQ either before or after the issuance of this RFQ

(a) is the sole property of the City and must be treated as confidential;

(b) is not to be used for any purpose other than replying to this RFQ and the performance of any subsequent contract for the Deliverables;

(c) must not be disclosed without prior written authorization from the City; and

(d) must be returned by the respondent to the City immediately upon the request of the City.

3.5.2 Confidential Information of Respondent

A respondent should identify any confidential information in its quotation or any accompanying documentation. The City will make reasonable efforts to safeguard confidential information of respondents, subject to its disclosure requirements under the Municipal Freedom of Information and Protection of Privacy Act or any other disclosure requirements imposed by law or by order of a court tribunal. Respondents are advised that their quotations will, as necessary, be disclosed, on a confidential basis, to advisers retained by the City to advise or assist with the RFQ process, including the evaluation of quotations. In addition, respondents are advised that certain contractual information, including pricing information, may be disclosed to City Council and, accordingly, may become part of the public record. If a respondent has any questions about the collection and use of information pursuant to this RFQ, questions are to be submitted to the RFQ Contact.

3.6 Procurement Process Non-binding

3.6.1 No Contract A and No Claims

This procurement process is not intended to create and will not create a formal, legally binding bidding process and will instead be governed by the law applicable to direct commercial negotiations. For greater certainty and without limitation:

(a) this RFQ will not give rise to any Contract A–based tendering law duties or any other legal obligations arising out of any process contract or collateral contract; and

(b) neither the respondent nor the City will have the right to make any claims (in contract, tort, or otherwise) against the other with respect to the award of a contract, failure to award a contract or failure to honour a quotation submitted in response to this RFQ.

3.6.2 No Contract until Execution of Written Agreement

This RFQ process is intended to solicit non-binding quotations for consideration by the City and may result in an invitation by the City to a respondent to enter into the Agreement. No legal relationship or obligation regarding the procurement of any good or service will be created

between the respondent and the City by this RFQ process until the execution of a written agreement for the acquisition of such goods and/or services.

3.6.3 Non-binding Price Estimates

While the pricing information provided in quotations will be non-binding prior to the execution of a written agreement, such information will be assessed during the evaluation of the quotations and the ranking of the respondents. Any inaccurate, misleading or incomplete information, including withdrawn or altered pricing, could adversely impact any such evaluation or ranking or the decision of the City to enter into an agreement for the Deliverables.

3.6.4 Cancellation

The City may cancel or amend the RFQ process without liability at any time.

3.7 Governing Law and Interpretation

These Terms and Conditions of the RFQ Process (Part 3):

(a) are intended to be interpreted broadly and independently (with no particular provision intended to limit the scope of any other provision);

(b) are non-exhaustive and must not be construed as intending to limit the pre-existing rights of the parties to engage in pre-contractual discussions in accordance with the common law governing direct commercial negotiations;

(c) are to be governed by and construed in accordance with the laws of the province of Ontario and the federal laws of Canada applicable therein; and

(d) if a respondent is required by applicable law to hold or obtain a licence, permit, consent or authorization to carry on an activity contemplated in its quotation, neither acceptance of the quotation nor execution of the contract shall be considered to be approval by the City of carrying on such activity without their requisite licence, permit, consent or authorization.

[End of Part 3]

APPENDIX A – FORM OF AGREEMENT

The contract form for the project shall be the Canadian Construction Documents Committee CCDC 2-2020 Stipulated Price Contract (not attached hereto but shall form part of the contract) as amended by the City of Brantford's proposed Supplementary Conditions.

SUPPLEMENTARY CONDITIONS
AMENDMENTS TO CCDC 2-2020 STIPULATED PRICE CONTRACT

These Supplementary Conditions modify, delete and/or add to the Agreement between Owner and Contractor, the Definitions, and the General Conditions of the Stipulated Price Contract, Standard Construction Document CCDC 2 – 2020.

SC 1. AGREEMENT BETWEEN OWNER AND CONTRACTOR

SC 1.1 ARTICLE A-5 PAYMENT

1.1.1 Delete paragraph 5.2 and replace it with the following:

"5.2 Should either party fail to make payments as they become due under this *Contract* or in an award by arbitration, adjudication or court, interest will begin to accrue on the amount that is not paid from the date when it is due until the date it is paid at the prejudgment interest rate prescribed by the Courts of Justice Act (Ontario)."

SC 1.2 ARTICLE A-6 RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING

1.2.1 Amend paragraph 6.2 by deleting the words "other form of electronic communication" and replacing them with "e-mail".

1.2.2 Amend paragraph 6.4 by deleting the words "any form of electronic communication" and replacing them with "e-mail".

SC 1.3 ARTICLE A-10 EXECUTION OF THE CONTRACT

1.3.1 Add a new Article A-10 as follows:

"**ARTICLE A-10 EXECUTION OF THE CONTRACT**

10.1 This *Contract* may be executed in counterparts and each of which so executed shall be deemed to be an original and such counterparts together shall constitute one and the same instrument and, notwithstanding their date of execution, shall be deemed to bear date as of the date first written above. The parties agree that this *Contract* may be transmitted by electronic transmission (scanned and transmitted by email) or other form of electronic document execution and delivery method (such as DocuSign), and that the reproduction of signatures by way of electronic means will be treated as though such reproductions were executed originals and shall be binding upon each party."

SC 2. DEFINITIONS

2.1.1 Amend the following Definitions:

(a) Amend the Definition of "***Consultant***" by adding the following to the end:

"For purposes of this *Contract*, the terms "*Consultant*", "Architect" and "Engineer", wherever used in the *Contract Documents*, shall be considered synonymous."

(b) Amend the Definition of "***Payment Legislation***" so that, as amended, it reads as follows:

"*Payment Legislation* means the Construction Act (Ontario) as amended, and all regulations made thereunder."

2.1.2 Add the following new Definitions:

(a) **As-Built Drawings**

"*As-Built Drawings* are the drawings prepared by the *Contractor* indicating as-built conditions and changes from the *Drawings* which occur during the course of the *Work* including, but not limited to, the exact location of major building components and structures that were shown generally on the *Drawings*. For certainty, *As-Built Drawings* shall be in computer-aided design (CAD) format approved by the *Owner*, as well as in paper and PDF formats."

(b) **Deficiency Rectification Security**

"*Deficiency Rectification Security* means the amount to be delivered by the *Contractor* pursuant to paragraph 5.4A.2 of GC 5.4A – DEFICIENCY RECTIFICATION SECURITY."

(c) **Key Personnel**

"*Key Personnel* has the meaning assigned to such term in paragraph 3.5.3 of GC 3.5 – SUPERVISION."

(d) **OHSA**

"*OHSA* means the Occupational Health and Safety Act (Ontario), as amended, and all rules and regulations passed under it."

(e) **Proper Invoice**

"*Proper Invoice* means an application for payment given by the *Contractor* to the *Owner* that fully complies with the requirements of GC 5.1A – PROPER INVOICE."

(f) **Unrecoverable Costs**

"*Unrecoverable Costs* means all costs of head office personnel and overhead costs, standby time or impact costs, any consequential, punitive, exemplary, indirect or special damages, and any loss of profit or loss of opportunity costs and damages, whether incurred or suffered by the *Contractor* or any *Subcontractor* or *Supplier*."

(g) **WSIB**

"*WSIB* means the Ontario Workplace Safety & Insurance Board."

SC 3. GENERAL CONDITIONS

SC 3.1 GC 1.1 CONTRACT DOCUMENTS

3.1.1 Delete paragraph 1.1.1 and replace it with the following:

"1.1.1 The intent of the *Contract Documents* is to include all labour, *Products*, materials, *Construction Equipment* and services necessary or normally considered necessary for the performance of the *Work*. Any item of *Work* mentioned in the *Contract Documents* or reasonably inferable from the *Contract Documents* but not otherwise shown or described, shall be provided by the *Contractor* as if shown or otherwise described or inferable. Any items omitted from the *Contract Documents* which are reasonably necessary or inferable for the completion of the *Work* or related work shall be considered a portion of the *Work* and included in the scope of *Work* to be performed under this *Contract*."

3.1.2 Amend paragraph 1.1.5.1 by changing the order of the first four bullet points so that, as reordered, the bullet points read as follows:

"- Supplementary Conditions,
- the Agreement between *Owner* and *Contractor*,
- the Definitions,
- the General Conditions"

3.1.3 Add a new paragraph 1.1.5A as follows:

"1.1.5A Notwithstanding paragraph 1.1.5, if there is a conflict or discrepancy between the requirements of two or more *Contract Documents* in relation to the amount or quality of labour or materials required to complete a particular item of *Work*, the *Contractor* shall supply and shall include in the *Work* the labour and materials which would provide the greatest benefit to the *Owner*, as determined by the *Owner*."

3.1.4 Amend paragraph 1.1.9 by adding new paragraphs 1.1.9.1 and 1.1.9.2 as follows:

"1.1.9.1 The *Contract Documents* shall be read as a whole and are the minimum construction requirements. If the *Contractor* finds discrepancies in, or omissions from, the *Drawings*,

Specifications or other *Contract Documents* or has any doubt as to the meaning or intent of any part thereof, he shall at once notify the *Consultant*, who will send written instructions or explanations.

1.1.9.2 The *Drawings* are intended to convey the scope of the *Work* and indicate general and approximate locations, arrangement and sizes of fixtures, equipment, outlets, utilities and underground services. The *Contractor* shall obtain more accurate information and shall satisfy itself as to the locations, arrangement and sizes of fixtures, equipment, outlets, utilities and underground services from study and coordination of the *Drawings*, including *Shop Drawings*, and shall become familiar with conditions and spaces affecting these matters before proceeding with the *Work*. Where site conditions require reasonable minor changes to indicated locations and arrangements, the *Contractor* shall make such changes at no additional cost to the *Owner*. Similarly, where known conditions or existing conditions interfere with new installation and require relocation, the *Contractor* shall include such relocation in the *Work* at no additional cost to the *Owner*. The *Contractor* shall arrange and install fixtures and equipment in such a way as to conserve as much headroom and space as possible."

3.1.5 Add new paragraphs 1.1.12 to 1.1.14 as follows:

"1.1.12 The *Contractor* shall review the *Contract Documents* and shall report promptly to the *Consultant* any error, inconsistency or omission the *Contractor* may discover. Provided it has exercised the degree of care and skill described in GC 3.11 – CONTRACTOR'S STANDARD OF CARE, the *Contractor* shall not be liable for damages or costs resulting from such errors, inconsistencies or omissions in the *Contract Documents* which the *Contractor* did not discover.

1.1.13 If the *Contractor* finds any error, inconsistency or omission in the *Contract Documents* or has any doubt as to the meaning or intent of any part thereof, the *Contractor* shall immediately notify the *Consultant*, who will provide written instructions or explanations. Neither the *Owner* nor the *Consultant* will be responsible for oral instructions.

1.1.14 Notwithstanding paragraphs 1.1.12 and 1.1.13, errors, inconsistencies and/or omissions shall not include lack of reference on the *Drawings* or in the *Specifications* to labour and/or *Products t*hat are normally required or normally recognized within respective trade practices as being necessary for the complete execution of the *Work*."

SC 3.2 GC 1.3 RIGHTS AND REMEDIES

3.2.1 Add a new paragraph 1.3.3 as follows:

"1.3.3 To be effective, the *Owner's* waiver of a right or remedy under this *Contract* must be expressly written by an authorized representative of the *Owner*. For greater certainty, actions of the *Owner* which shall not constitute a waiver include, but are not limited to, the following:

.1 making partial payments to the *Contractor*;
.2 any partial or entire use or occupancy of the *Project*;
.3 final acceptance of the *Work*;
.4 failure to object to known defects;
.5 specifying a list of defects will not be held a waiver of defects not listed."

SC 3.3 GC 1.4 ASSIGNMENT

3.3.1 Delete paragraph 1.4.1 and replace it with the following:

"1.4.1 The *Owner* may assign the *Contract* or a portion thereof without the consent of the *Contractor* where such assignment is to an entity undertaking the *Project* for the use of the *Owner*. The *Contractor* shall not assign the *Contract* or any portion thereof or its interest therein without the written consent of the *Owner*, which consent may be unreasonably and arbitrarily withheld. In the event of an assignment of the *Contract* by the *Contractor*, such assignment shall not relieve the *Contractor* from its obligations and liabilities under this *Contract*. "

SC 3.4 GC 1.5 CONFIDENTIALITY

3.4.1 Add a new GC 1.5 as follows:

"GC 1.5 CONFIDENTIALITY

1.5.1 The *Contractor* shall keep confidential all matters respecting technical and commercial issues relating to or arising from the performance of the *Contract* and shall not, without the prior written consent of the *Owner*, disclose any such matters, except in strict confidence, to:

.1 its employees, *Subcontractors* and *Suppliers* who have a need to know the same in order to use the same in connection with the *Work* and the *Project*; and

.2 its professional advisors but only to the extent as may be required by government authorities or applicable law.

The confidentiality restrictions shall not apply to any information that is required to be disclosed by applicable law, regulations or judicial process. Provided, however, that the *Contractor* shall give *Owner* at least ten (10) *Working Days'* prior written notice of any intended disclosure together with the relevant provision of law, regulation or judicial process under which the disclosure is intended to be made, and the *Contractor* shall cooperate with the *Owner* and its legal counsel in connection with any protective order or other appropriate remedies the *Owner* may seek to prevent or limit such disclosure."

SC 3.5 GC 2.2 ROLE OF THE CONSULTANT

3.5.1 Amend paragraph 2.2.12 by adding the following to the end:

"If the *Contractor* believes a *Supplemental Instruction* will result in either a change to the *Contract Price* or the *Contract Time*, the *Contractor* shall, within five (5) *Working Days* of receipt of such *Supplemental Instruction*, provide the *Consultant* with a *Notice in Writing* to that effect and shall await further instructions. The *Contractor's* failure to provide such *Notice in Writing* within the time stipulated in this paragraph shall be deemed an acceptance of the *Supplemental Instruction* by the *Contractor* without adjustment to the *Contract Price* or *Contract Time*."

3.5.2 Amend paragraph 2.2.18 by deleting the words "against whom the *Contractor* makes no reasonable objection and".

SC 3.6 GC 2.4 DEFECTIVE WORK

3.6.1 Amend paragraph 2.4.1 as follows:

(a) insert the words ", at the *Contractor's* sole cost and expense," after the words "The *Contractor* shall" in the first line; and

(b) add the following to the end:

"The *Contractor* shall promptly pay to the *Owner* all costs, damages and loss incurred by the *Owner* for *Work* destroyed or damaged or for any alterations necessitated by the *Contractor's* removal, replacement or re-execution of defective portions of the *Work*. The *Owner* shall be entitled to set-off and deduct all such costs, damages and loss against amounts owing to the *Contractor* under this *Contract*."

3.6.2 Add a new paragraph 2.4.4 as follows:

"2.4.4 The *Contractor* shall prioritize the correction of any defective work or deficiencies identified as priorities by the *Owner* or the *Consultant*."

SC 3.7 GC 3.1 CONTROL OF THE WORK

3.7.1 Amend paragraph 3.1.2 by adding the word "schedules," after the word "techniques,".

3.7.2 Add new paragraphs 3.1.3 to 3.1.6 as follows:

"3.1.3 The *Contractor* is solely responsible for the quality of the *Work* and shall undertake any quality control activities specified in the *Contract Documents* or, if none are specified, as may be reasonably required to ensure such quality. The *Contractor* shall perform the *Work* in accordance with modern practice and in accordance with applicable laws, ordinances, rules, regulations or codes relating to the performance of the *Work*. Without limiting the generality of

the foregoing, the *Contractor* is responsible for coordinating the *Work* so that no part shall be left in an unfinished or incomplete condition.

3.1.4 The *Contractor* shall abide by and shall enforce directives and policies regarding signs, advertisements, fires, smoking and vaping at the *Place of the Work* as directed by the *Owner*.

3.1.5 The *Contractor*, without in any way limiting its responsibilities under this *Contract*:

.1 shall perform the *Work* so as to avoid disturbing the occupants of any facilities, premises, or the public in general;

.2 shall respect and comply with local regulations and all *Owner's* requirements regarding permitted work hours, noise levels and work conditions;

.3 shall abide by and enforce *Owner* directives and policies regarding signs, advertisements, fires and smoking at the *Place of the Work* as directed by the *Owner*;

.4 shall take all reasonable steps to avoid interference with fire exits, building or site access and egress, continuity of electric power and all other utilities, to suppress dust and noise, to avoid conditions likely to propagate mould or fungus of any kind, and shall take all other steps reasonably necessary to promote and maintain the safety and comfort of the users and occupants of any facilities, premises and the public in general, and to maintain access to and the operation of any existing facilities at the *Place of the Work*;

.5 shall take precautions not to allow any unauthorized visitors entry to the *Place of the Work*;

.6 shall not permit any worker or *Subcontractors* to use any existing facilities including, without limitation, elevators, lavatories, toilets, entrances, and parking areas other than those designated by the *Owner.*

3.1.6 Prior to commencing the *Work* the *Contractor* shall verify 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 exact locations are not apparent in the *Contract Documents*, the *Contractor* shall immediately notify the *Consultant* in writing and shall obtain written instructions before proceeding with any part of the affected *Work*. Failure to do so shall be at the sole risk and cost of the *Contractor*."

SC 3.8 GC 3.2 CONSTRUCTION BY THE OWNER OR OTHER CONTRACTORS

3.8.1 Delete paragraph 3.2.2.

3.8.2 Amend paragraph 3.2.3.4 by adding the following to the end:

"Failure by the *Contractor* to so report shall invalidate any claims against the *Owner* by reason of the deficiencies in the work of *Other Contractors* or *Owner's* own forces except for those deficiencies not then reasonably discoverable; and"

3.8.3 Add a new paragraph 3.2.3.5 as follows:

"3.2.3.5 assume overall responsibility for the *Owner's* own forces and for *Other Contractors* for compliance with all aspects of the applicable health and construction safety legislation at the *Place of the Work*, including all of the responsibilities of the "constructor" under the *OHSA*."

3.8.4 Add a new paragraph 3.2.7 as follows:

"3.2.7 The placement, installation, application and connection of work by the *Owner's* own forces or by *Other Contractors* on and to the *Work* shall not relieve the *Contractor* of its responsibility to provide and maintain the warranties specified in this *Contract*. If the *Contractor* is of the view that the work of *Other Contractors* or the work of the *Owner's* own forces will compromise, void or nullify any of the warranties to be provided pursuant to this *Contract*, the *Contractor* shall immediately give *Notice in Writing* to the *Owner* and shall include in such notice the reasons why, in the *Contractor's* view, a warranty or warranties will be compromised, voided or nullified, together with the *Contractor's* recommendations for avoiding such result."

SC 3.9 GC 3.4 CONSTRUCTION SCHEDULE

3.9.1 Delete paragraph 3.4.1 and replace it with the following:

"3.4.1 The *Contractor* shall:

.1 within ten (10) *Working Days* of signing this *Contract* submit to the *Owner* and the *Consultant*, for the *Owner's* approval, a construction schedule that indicates the timing of major activities and critical milestone dates for the *Work*, demonstrating that the *Work* will be performed in conformity with the *Contract Time*. Such schedule:

(a) shall be prepared using a scheduling software approved in writing by the *Owner*, and

(b) shall be provided in both a native editable electronic format that includes and shows all logic links between activities, and in paper format, and

(c) shall be prepared in collaboration with, and supported by, the *Subcontractors* and *Suppliers* whose activities affect the critical path of the *Work*, and

(d) shall include and make provision for statutory holidays, weather conditions that are normally experienced at the *Place of the Work*, and the rectification of defects and deficiencies, and

(e) shall provide sufficient detail of the critical events and their inter-relationship and shall include a baseline schedule indicating the critical path for the *Project*; and

.2 provide the expertise and resources, including labour and *Construction Equipment*, as are necessary to maintain progress under the construction schedule; and

.3 monitor the adequacy of *Subcontractor* and *Supplier* personnel and equipment and the availability of *Products* to meet the construction schedule and take appropriate action when requirements of a contract with a *Subcontractor* or *Supplier* are not being met; and

.4 monitor the progress of the *Work* on a weekly basis relative to the construction schedule, update the schedule on a monthly basis, and immediately advise the *Owner* and the *Consultant* in writing of any variation from the baseline or slippage in the schedule; and

.5 at each site meeting provide to the *Owner* and the *Consultant* a look-ahead schedule indicating the major activities to be undertaken in the next month.

3.4.2 If at any time the *Contractor* forms the opinion or anticipates that the progress of the *Work* is behind schedule or is likely to fall behind schedule the *Contractor* shall take appropriate steps, at the *Contractor's* own expense, to cause the actual progress of the *Work* to conform to the schedule and shall produce and present to the *Owner* and the *Consultant*, for review and approval, a recovery plan demonstrating how the *Contractor* will achieve recovery of the schedule.

3.4.3 The *Contractor* shall not change the scheduled *Ready-for-Takeover* date."

SC 3.10 GC 3.4A CONTRACTOR'S MONTHLY REPORTS

3.10.1 Add a new GC 3.4A as follows:

"**GC 3.4A CONTRACTOR'S MONTHLY REPORTS**

3.4A.1 The *Contractor* shall prepare and deliver a monthly written report to the *Owner* and the *Consultant* on the status of the *Project*. Such monthly report shall include:

.1 an overview of the state and progress of the *Work*;

.2 confirmation that the *Work* is on schedule or, if the schedule has suffered slippage, a recovery plan demonstrating how the *Contractor* will achieve recovery of the schedule;

.3 a list of critical issues of which the *Contractor* is aware and which require resolution, including dates by which decisions are required and by whom;

.4 proposed or anticipated changes of which the *Contractor* is aware, and their expected impacts on the *Project*;

.5 claims or anticipated claims of which the *Contractor* is aware, including claims against the *Contractor*, the *Owner*, or the *Project*;

.6 the *Contractor's* proposed plan and schedule for repairing, correcting or reworking of any defective work;

.7 an updated construction schedule which conforms to the requirements of paragraph 3.4.1.1 of GC 3.4 – CONSTRUCTION SCHEDULE.

3.4A.2 The *Contractor's* monthly report shall be included with its monthly application for progress payment."

SC 3.11 GC 3.5 SUPERVISION

3.11.1 Amend paragraph 3.5.1 by adding the following to the end:

", and upon the *Contractor* obtaining the *Owner's* prior written consent, which consent will not be unreasonably withheld."

3.11.2 Add a new paragraph 3.5.3 as follows:

"3.5.3 The *Contractor's* key team members and personnel for the *Project* ("***Key Personnel***") are listed in the Schedule attached to the Supplementary Conditions. The *Contractor* shall ensure the *Key Personnel* remain on the *Project* for the duration of the *Project* and shall not permit any *Key Personnel* to be changed, substituted, replaced or reassigned without the prior written approval of the *Owner*. If the *Owner* approves a change in *Key Personnel*, the *Contractor* shall promptly arrange for an appointment of a replacement person of comparable or greater experience, subject to the *Owner's* written approval. The *Contractor* shall provide to the *Owner* all relevant information on each proposed replacement person, including a current resume and synopsis of the individual's roles on previous projects. All costs associated with the transition of replacement personnel onto the *Project* shall be at the sole cost and expense of the *Contractor*."

SC 3.12 GC 3.6 SUBCONTRACTORS AND SUPPLIERS

3.12.1 Amend paragraph 3.6.2 as follows:

(a) by deleting the words "before signing the *Contract*" in the third line; and

(b) by adding the following to the end:

"If the *Contractor* wishes to change any *Subcontractors* or *Suppliers,* the *Contractor* shall advise the *Owner* in writing and give the reasons for the proposed change. The *Contractor* shall not change *Subcontractors* or *Suppliers* without the *Owner's* prior written approval, which approval will not be unreasonably withheld."

3.12.2 Amend paragraph 3.6.3 by deleting the words "before the *Owner* has signed the *Contract*," in the first line.

3.12.3 Add a new paragraph 3.6.7 as follows:

"3.6.7 Notwithstanding paragraph 3.6.5, the *Owner* may assign to the *Contractor*, and the *Contractor* shall accept the assignment of, any contract for *Work* or *Products* required on the *Project* that has been procured or negotiated by or on behalf of the *Owner*. In such event the *Contract Price* shall be increased by the balance of the contract price remaining under such assigned contract."

SC 3.13 GC 3.7 LABOUR AND PRODUCTS

3.13.1 Amend paragraph 3.7.1 as follows:

(a) insert the words "agents, *Subcontractor*s and *Suppliers*" after the word "employees" in the first line; and

(b) add the following to the end:

"Without in any way limiting the generality of the foregoing, the *Contractor* shall prepare and implement the job site rules more particularly described in the *Contract Documents*. If no job site rules are described in the *Contract Documents*, the *Contractor* shall draft job site rules for the review and approval of the *Consultant* and the *Owner*. Such job site rules prepared by the *Contractor* shall be consistent with the *Contractor*'s duties and obligations under *OHSA*, shall include and incorporate all *Owner's* policies and protocols relating to construction and working in *Owner* facilities, and shall

include provisions making smoking, vaping and the consumption of alcohol or non-prescription drugs on the *Project* site the subject of discipline proceedings and/or termination of employment."

3.13.2 Add new paragraphs 3.7.4 to 3.7.8 as follows:

"3.7.4 The *Contractor* shall ensure that all materials and *Products* are delivered to the *Project* site in original containers and packages with labels and seals intact and that they are protected from the elements and visible for inspection by the *Owner* and/or the *Consultant*.

3.7.5 The *Contractor* is responsible for the safe on-site storage of *Products* and their protection (including *Products* supplied by the *Owner* and *Other Contractors*) so as to avoid dangerous conditions, deterioration, damage or contamination to the *Products*, persons, or property and in locations at the *Place of the Work* to the satisfaction of the *Owner* and the *Consultant*.

3.7.6 The *Owner* or the *Consultant*, acting reasonably, shall have the right to order the *Contractor* to remove from the *Project*, without cost to the *Owner*, any representative or employee of the *Contractor* or any representative or employee of any *Subcontractor* or *Supplier* whose conduct, in the opinion of the *Owner* or the *Consultant*, jeopardizes the safety or security of the *Project*, any person, the *Owner's* operations, is a detriment to the *Project*, or whose behaviour may be considered as harassment in the workplace. Immediately upon receipt of such order the *Contractor* shall make arrangements for the appointment of a replacement representative or employee acceptable to the *Owner*. All costs associated with the transition of replacement staff onto the *Project* shall be at the sole cost and expense of the *Contractor*.

3.7.7 The *Contractor* shall not, and shall ensure that its *Subcontractors* and *Suppliers* do not, employ any person on the *Project* whose labour affiliation or lack thereof is incompatible with other labour employed in connection with the *Work*. All costs arising from labour disputes arising from the *Contractor's* failure to comply with this paragraph shall be the sole expense of the *Contractor*.

3.7.8 The *Contractor* shall cooperate with the *Owner*, the *Consultant* and their representatives and shall take all reasonable and necessary actions to maintain stable and harmonious labour relations at the *Place of the Work*, including cooperation to attempt to avoid *Work* stoppages, trade union jurisdictional disputes, and other labour disputes."

SC 3.14 GC 3.8 SHOP DRAWINGS

3.14.1 Amend paragraph 3.8.1 by adding the following to the end:

"Prior to the first application for payment, the *Contractor* shall prepare a schedule for the dates of submission, review and return of *Shop Drawings* and shall deliver it to the *Consultant* and *Owner* for review and approval. The draft *Shop Drawings* schedule shall clearly indicate the phasing of *Shop Drawings* and submissions."

3.14.2 Add new paragraphs 3.8.8 to 3.8.11 as follows:

"3.8.8 Reviewed *Shop Drawings* shall not authorize a change in the *Contract Price* or the *Contract Time*.

3.8.9 The *Contractor* shall not use the term "by others" on *Shop Drawings* and shall identify the responsible *Subcontractor* or *Supplier* where such work is within the scope of the *Work*.

3.8.10 Where *Specifications* require the *Shop Drawings* to bear the seal and signature of a professional, such professional shall be registered in the jurisdiction of the *Place of the Work* and shall have expertise in the area of practice reflected in the *Shop Drawings*.

3.8.11 The *Consultant's* review of the *Shop Drawings* shall not relieve the *Contractor* from responsibility for defective *Work* resulting from errors or omissions of any kind on the reviewed *Shop Drawings* and shall not constitute authorization to the *Contractor* to perform additional *Work* or changed *Work*. The *Contractor* is solely responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes, and for techniques of construction and installation."

SC 3.15 GC 3.9 USE OF THE WORK

3.15.1 Add a new GC 3.9 as follows:

"**GC 3.9 USE OF THE WORK**

3.9.1 The *Contractor* shall confine *Construction Equipment, Temporary Work,* storage of *Products*, waste products and debris, and operations of employees, *Subcontractors* and *Suppliers* to limits indicated by laws, ordinances, permits, or the *Contract Documents*, and shall not unreasonably encumber the *Place of the Work*.

3.9.2 The *Contractor* shall not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety of the *Work*."

SC 3.16 GC 3.10 CLEANUP

3.16.1 Add a new GC 3.10 as follows:

"**GC 3.10 CLEANUP**

3.10.1 The *Contractor* shall:

.1 maintain the *Work* and the *Place of the Work* in a safe and tidy condition and free from the accumulation of waste products and debris;

.2 ensure the *Place of the Work* is cleaned and left in a tidy condition on a daily basis.

If the *Contractor* fails to remove waste and debris as provided in this GC 3.10, then, the *Owner* may remove such waste and debris and deduct from payments otherwise due to the *Contractor* the costs of doing so.

3.10.2 Before delivering the application for *Ready-for-Takeover* the *Contractor* shall remove all surplus *Products*, tools, *Construction Equipment, Temporary Work*, waste products and debris and shall ensure the *Place of the Work* is clean and tidy and suitable for occupancy by the *Owner*."

SC 3.17 GC 3.11 CONTRACTOR'S STANDARD OF CARE

3.17.1 Add a new GC 3.11 as follows:

"**GC 3.11 CONTRACTOR'S STANDARD OF CARE**

3.11.1 In performing this *Contract* the *Contractor* shall exercise a standard of care, skill, judgment and diligence that would normally be exercised by an experienced, skilled and prudent contractor performing similar work for similar projects. The *Contractor* acknowledges and agrees that, throughout this *Contract*, the *Contractor's* obligations, duties and responsibilities shall be interpreted in accordance with this standard. The *Contractor* shall exercise the same standard of care, skill, judgment and diligence in respect of any *Products*, *Subcontractors*, *Suppliers*, personnel or procedures which it may employ on the *Project*.

3.11.2 The *Contractor* represents, covenants and warrants to the *Owner* that:

.1 the *Contractor's* personnel assigned to the *Project* are appropriately experienced and trained;

.2 it has sufficient qualified and competent personnel to replace its designated supervisor, superintendent and project manager, subject to the *Owner's* approval, in the event of incapacity, removal or resignation; and

.3 there are no pending, threatened or anticipated claims that would have a material effect on the financial ability of the *Contractor* to perform this *Contract*."

SC 3.18 GC 3.12 CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS

3.18.1 Add a new GC 3.12 as follows:

"**GC 3.12 CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS**

3.12.1 The *Contractor* shall not make use of elements of the mechanical and electrical systems or equipment comprising a permanent part of the *Work*, including the HVAC system and elevators, without the *Owner's* prior express written consent obtained in accordance with this GC 3.12.

3.12.2 If the *Contractor* wishes to make use of such systems or equipment the *Contractor* shall, before using such systems or equipment:

.1 obtain the manufacturer's instructions regarding the preventative maintenance services to be performed on such systems and equipment; and

.2 submit a written request to the *Owner* for consent to use such systems or equipment, which request shall include all of the information received from the manufacturer of such systems or equipment and shall include the *Contractor's* comprehensive operation and preventative maintenance plan for such systems and equipment.

3.12.3 If the *Owner* issues a written consent to the *Contractor's* use of elements of the mechanical and electrical systems or equipment comprising a permanent part of the *Work*, the *Contractor* shall:

.1 operate and maintain such systems and equipment in strict compliance with the requirements set out in the *Specifications*, any instructions received from the manufacturers of such systems and equipment, and the *Contractor's* comprehensive operation and preventative maintenance plan; and

.2 perform all preventative maintenance services on such systems and equipment in accordance with the *Specifications*, any instructions received from the manufacturers of such systems and equipment, and the *Contractor's* comprehensive operation and maintenance plan; and

.3 before applying *for Ready-for-Takeover*, clean and make good, to the satisfaction of the *Owner*, all such systems and equipment as it had been permitted to use; and

.4 pay any and all costs associated with such use, operation, preventative maintenance services, cleaning and making good at no cost or charge to the *Owner*."

SC 3.19 GC 4.1 CASH ALLOWANCES

3.19.1 Add a new paragraph 4.1.8 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."

SC 3.20 GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

3.20.1 Delete GC 5.1.

SC 3.21 GC 5.1A PROPER INVOICE

3.21.1 Add a new GC 5.1A as follows:

"**GC 5.1A PROPER INVOICE**

5.1A.1 In this *Contract* a *Proper Invoice* shall mean an application for payment made by the *Contractor* that:

.1 is given to the *Owner* monthly by e-mail sent to "●.com" and is sent concurrently to the *Consultant* by e-mail, or as the *Owner* may otherwise direct; and

.2 includes all of the following:

.1 the *Contractor's* name and address and HST registration number;

.2 the date of the application for payment and the period during which the services or materials were supplied;

.3 information identifying the authority, whether in the *Contract* or otherwise, under which the services or materials were supplied, including the applicable RFT or purchase order number;

.4 a description, including quantities where appropriate, of the services and materials that were supplied;

.5 the amount payable for the services or materials that were supplied, and the payment terms. Ensure the amounts align with the *Contractor's* pricing form;

.6 the name, title, telephone number and mailing address of the person to whom payment is to be sent;

.7 copies of all *Change Orders* and *Change Directives* for which the *Contractor* is claiming payment together with all backup documentation;

.8 a statement based on the schedule of values for the *Work*,

.9 for all applications for payment except the final payment, the monthly report required by GC 3.4A – CONTRACTOR'S MONTHLY REPORTS, including an updated construction schedule which complies with the requirements of paragraph 3.4.1.1 of GC 3.4 – CONSTRUCTION SCHEDULE;

.10 a current valid clearance certificate issued by the *WSIB*;

.11 for the second and all subsequent applications for payment, a CCDC 9A Statutory Declaration stating that all accounts for services and materials and other indebtedness incurred by the *Contractor* for which the *Owner* may in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified matter in dispute."

SC 3.22 GC 5.2 APPLICATIONS FOR PAYMENT

3.22.1 Delete paragraphs 5.2.1 and 5.2.2 and replace them with the following:

"5.2.1 *Proper Invoices* for progress payment shall be given monthly to the *Owner* and the *Consultant* as the *Work* progresses on a day of the month agreed to by the parties.

5.2.2 Five (5) *Working Days* before submitting a *Proper Invoice* the *Contractor* shall convene a meeting with the *Owner*, the *Consultant*, and those *Subcontractors* whose *Work* is to be included in the *Proper Invoice*, for the purpose of reviewing the progress of the *Work* and to review a draft *Proper Invoice*. For certainty, the purpose of such meeting is not to pre-certify or pre-approve the *Proper Invoice*."

3.22.2 Amend paragraph 5.2.3 by adding the following to the end:

"No amount claimed shall include *Products* delivered to the *Place of the Work* unless the *Products* are free and clear of all security interests, liens, and other claims of third parties."

3.22.3 Delete paragraph 5.2.4 and replace it with the following:

"5.2.4 The *Contractor* shall, within 15 *Working Days* after signing this *Contract*, submit to the *Consultant*, for the *Consultant's* approval, a schedule of values for the parts of the *Work* aggregating the total amount of the *Contract Price*, so as to facilitate evaluation of applications for payment. Such schedule of values:

.1 shall include a detailed breakdown of the *Work*; and

.2 shall include line items which assign an appropriate portion of the *Contract Price* for the preparation and delivery of *As-Built Drawings*, quality control, and closeout of the *Work*.

Once approved, this schedule of values shall be the basis of payment unless shown to be in error."

3.22.4 Amend paragraph 5.2.6 by adding the following to the end:

", as modified by paragraph 5.1A.1.2 of GC 5.1A – PROPER INVOICE."

3.22.5 Amend paragraph 5.2.8 by adding the following to the end:

"Any *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall remain at the risk of the *Contractor* notwithstanding that title has passed to the *Owner* pursuant to GC 14.2 – OWNERSHIP OF MATERIALS."

SC 3.23 GC 5.3 PAYMENT

3.23.1 Delete paragraph 5.3.1 and replace it with the following:

"5.3.1 After receipt by the *Consultant* and the *Owner* of an application for progress payment given by the *Contractor* in accordance with GC 5.2 – APPLICATIONS FOR PAYMENT, the *Consultant* will issue to the *Owner* and copy to the *Contractor*, no later than 10 calendar days after the date of receipt of a *Proper Invoice*, a certificate for payment in the amount applied for, or in such other amount as the *Consultant* determines to be properly due.

5.3.2 Subject to the *Owner's* right to give notice of non-payment in accordance with the *Payment Legislation*, and subject to the applicable statutory holdback provisions, the *Owner* will pay the amount payable under a *Proper Invoice* for progress payment no later than 28 days after the date the *Owner* receives the *Proper Invoice*. Provided that the *Owner's* obligation to make payment shall not arise unless and until the *Contractor's* application for payment constitutes a complete *Proper Invoice* as provided in GC 5.1A – PROPER INVOICE. For certainty, and without limitation, the *Owner* may refuse to pay all or any portion of an application for payment where:

.1 the application does not comply with all of the requirements of a *Proper Invoice* in GC 5.1A – PROPER INVOICE; and/or

.2 the *Owner* is entitled to deduct and retain amounts in accordance with the *Contract Documents*; and/or

.3 the amount applied for exceeds the amount certified for payment by the *Consultant* in the certificate for payment issued pursuant to paragraph 5.3.1."

SC 3.24 GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

3.24.1 Delete paragraphs 5.4.2 to 5.4.4 and replace them with the following:

"5.4.2 Immediately after the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor*:

.1 shall, in consultation with the *Owner* and the *Consultant*, establish reasonable dates for *Ready-for-Takeover* and for finishing the *Work* and correcting deficient *Work*; and

.2 shall cause the certificate to be published in the manner prescribed by the *Payment Legislation* and shall immediately deliver a copy of the published certificate to the *Owner*.

5.4.3 The *Contractor* shall submit an application for payment of the lien holdback amount which shall include all of the following.

.1 a written request for the release of the holdback amount;

.2 a declaration that no written notices of lien have been received by the *Contractor*;

.3 a copy of the published certificate of *Substantial Performance of the Work*;

.4 a current *WSIB* clearance certificate; and

.5 a CCDC 9A Statutory Declaration stating that all accounts for services and materials and other indebtedness incurred by the *Contractor* for which the *Owner* may in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified matter in dispute.

5.4.4 Subject to the *Owner's* right to give notice of non-payment of holdback in accordance with the *Payment Legislation*, the *Owner* will pay the amount authorized by the certificate for payment of the holdback in accordance with the *Payment Legislation*."

3.24.2 Delete paragraph 5.4.5 and replace it with the following:

"5.4.5 The *Contractor* may request the *Owner* to direct the *Consultant* to make a determination whether a *Subcontractor* contract has been completed prior to *Substantial Performance of the Work*. If the *Owner* agrees to so direct the *Consultant*, the *Contractor* shall submit documentation clearly identifying the *Work* and the *Subcontractor* involved and such other documents as are stipulated by the *Payment Legislation* or requested by the *Owner* or the *Consultant*. For greater certainty, the *Owner's* decision whether or not to direct the *Consultant* to determine if a *Subcontractor* contract has been completed is at the *Owner's* sole discretion.

5.4.5A If, after being directed to do so by the *Owner* pursuant to paragraph 5.4.5, the *Consultant* determines that a *Subcontractor* contract has been completed prior to *Substantial Performance of the Work*, the *Consultant* shall complete and issue a certificate of completion of subcontract in the form prescribed by the *Payment Legislation* and the *Owner* shall pay the *Contractor* the holdback amount retained for such subcontract work after the expiry of the applicable holdback period stipulated in the *Payment Legislation*."

SC 3.25 GC 5.4A DEFICIENCY RECTIFICATION SECURITY

3.25.1 Add a new GC 5.4A as follows:

"**GC 5.4A DEFICIENCY RECTIFICATION SECURITY**

5.4A.1 The *Contractor* shall, within 25 days after the date of *Substantial Performance of the Work*, deliver to the *Owner* the *Deficiency Rectification Security* in the amount determined in accordance with paragraph 5.4A.2 in the form of:

.1 an irrevocable standby letter of credit in a form satisfactory to the *Owner*; or

.2 a certified cheque or bank draft payable to the *Owner*.

5.4A.2 The amount to be paid by the *Contractor* (the "***Deficiency Rectification Security***") shall be:

.1 if the *Contract Price* is less than $100,000, the amount of $5,000 plus *Value Added Taxes*, or such other amount as the *Owner* may require;

.2 if the *Contract Price* is $100,000 or more but is less than $1,500,000, the amount equivalent to 5% of the *Contract Price*, plus *Value Added Taxes*;

.3 if the *Contract Price* is $1,500,000 or more but is less than $2,500,000, the amount equivalent to 3% of the *Contract Price*, plus *Value Added Taxes*;

.4 if the *Contract Price* is $2,500,000 or more, the amount equivalent to 1.5% of the *Contract Price*, plus *Value Added Taxes*.

5.4A.3 If the *Contractor* fails to deliver the *Deficiency Rectification Security* in accordance with paragraphs 5.4A.1 and 5.4A.2, the *Owner* may deduct and retain the *Deficiency Rectification Security* from any amount owing to the *Contractor*, and such retained amount shall take the place of and shall become the *Deficiency Rectification Security*.

5.4A.4 The *Owner* will use the *Deficiency Rectification Security* to cover the costs of correcting defects, deficiencies or non-compliant items of *Work* which appear prior to and during the warranty period, as described in paragraph 12.3.5A of GC 12.3 – WARRANTY."

SC 3.26 GC 5.5 FINAL PAYMENT

3.26.1 Delete paragraph 5.5.1 and replace it with the following:

"5.5.1 When the *Contractor* considers that the *Work* is completed, the *Contractor* shall deliver a *Proper Invoice* for final payment."

3.26.2 Amend paragraph 5.5.2 by adding the following to the end:

"Without limiting the generality of the foregoing, the application for final payment will not be considered valid until *Products* installed are tested and conform to the requirements specified in the *Contract Documents* and all documents required by the *Contract Documents* have been received and accepted by the *Consultant*."

3.26.3 Delete paragraphs 5.5.3 and 5.5.4 and replace them with the following:

"5.5.3 Subject to the *Owner's* right to give notice of non-payment in accordance with the *Payment Legislation*, the *Owner* will pay the amount payable under a *Proper Invoice* for final payment no later than 28 days after the date the *Owner* receives the *Proper Invoice*. Provided that the *Owner's* obligation to make payment shall not arise unless and until the *Contractor's* application for payment constitutes a complete *Proper Invoice* as provided in GC 5.1A – PROPER INVOICE."

SC 3.27 GC 5.8 WITHHOLDING OF PAYMENT

3.27.1 Add a new GC 5.8 as follows:

"**GC 5.8 WITHHOLDING OF PAYMENT**

5.8.1 Notwithstanding any provision in the *Contract Documents* to the contrary, the *Owner* may withhold payment of any amount claimed in an application for payment, in a *Proper Invoice*, or in any certificate for payment to the extent required to offset any claims the *Owner* may have

against the *Contractor*, or to offset previous overpayment made to the *Contractor*, or for damages or costs incurred by the *Owner*, or to the extent as may be necessary to protect and/or indemnify the *Owner* from loss, claims and/or damage, including from loss, claims and/or damage arising as a result of:

.1 the *Contractor's* failure to perform any of its material obligations or where the *Contractor* is otherwise in default under the *Contract Documents*, whether or not the *Contractor* has been noted in default;

.2 defective *Work* not remedied;

.3 damage done to work performed by *Other Contractors* or by the *Owner*'s own forces;

.4 the *Contractor's* failure to make prompt payments to its *Subcontractors* and *Suppliers* respecting *Work* for which the *Owner* has made payment to the *Contractor*;

.5 claims or reasonable evidence indicating possible commencement of claims for which the *Contractor* may be responsible to indemnify the *Owner*;

.6 the *Contractor's* failure to remove liens arising from the *Work* or to otherwise satisfy its obligations under GC 14.2 – LIENS AND ACTIONS;

.7 reasonable evidence the *Contractor* will not attain *Ready-for-Takeover* in accordance with the construction schedule or within the *Contract Time;*

.8 any claim for which the *Owner* is entitled to indemnification from the *Contractor* pursuant to the *Contract Documents*.

5.8.2 Where the *Owner* has withheld payment to the *Contractor* pursuant to the provisions of this *Contract*, the *Owner* shall be entitled to apply the funds withheld toward the costs of any required remedial work, completion costs or toward damages or losses suffered and for which the *Owner* is entitled to compensation under this *Contract*, including legal costs and expenses."

SC 3.28 GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

3.28.1 Amend paragraph 6.1.2 by adding the following to the end:

"All such changes require approval by a representative of the *Owner* with proper signing authority. The requirement that the *Contractor* obtain a *Change Order* or a *Change Directive* is of the essence and it is the express intention of the parties that any claims by the *Contractor* for a change in the *Contract Price* and/or *Contract Time* shall be barred unless there is strict compliance with PART 6 – CHANGES IN THE WORK. No course of conduct or dealings between the parties, no express or implied acceptance of alterations or additions to the *Contract* or the *Work*, and no claims that the *Owner* has been unjustly enriched by any alteration or addition to the *Work*, whether or not there is any such unjust enrichment, shall be the basis of a claim for damages or additional payment or for a change in the *Contract Price* or *Contract Time*. Without limiting the generality of the foregoing, under circumstances of expediency the *Contractor* shall proceed with a change in the *Work* without first obtaining a *Change Order* or a *Change Directive* where it has received from the *Owner* or the *Owner's* authorized representative some form of written or e-mail direction agreeing to the change, in which case such change, and the value of such change, if any, will be determined pursuant to GC 6.2 or GC 6.3, at the option of the *Owner*."

SC 3.29 GC 6.2 CHANGE ORDER

3.29.1 Add new paragraphs 6.2.3 to 6.2.6 as follows:

"6.2.3 The value of a change shall be determined in one or more of the following methods as directed by the *Owner*:

.1 by estimate and acceptance of a lump sum. The lump sum shall include overhead, profit and other reasonable charges and mark-ups and shall be the total cost to the *Owner*; or

.2 by unit prices established in the *Contract Documents* or subsequently agreed upon. Unit prices shall include all costs related to *Products*, labour, equipment, delivery and handling, statutory charges, overhead and profit, other related charges, and shall include all applicable duties (excluding HST), and shall be the total cost to the *Owner*. Adjustment to the *Contract Price* shall be based on a net quantity difference from the original quantity; or

.3 by actual credits and cost to the *Owner*. The cost to the *Owner* shall be the actual cost plus the following percentage fee for overhead and profit after all credits included in the change have been deducted. For certainty, no mark-up or other charges shall be permitted for

overhead and profit where the change results in a net decrease (credit) to the *Contract Price*:

(a) on *Work* performed by the *Contractor's* own forces, the *Contractor* may charge a maximum mark-up of 5% as a combined percentage fee for overhead and profit;

(b) on *Work* performed by *Subcontractors*, the *Subcontractors* may charge a maximum mark-up of 5% as a combined percentage fee for overhead and profit, and the *Contractor* may charge a maximum mark-up of 5% as a combined percentage fee for overhead and profit on the aggregate of the *Work* performed by *Subcontractors* (excluding the *Subcontractors'* fee mark-up).

6.2.4 The mark-ups referred to in paragraph 6.2.3.3 shall constitute the only compensation the *Contractor* shall be entitled to for any and all overhead, profit, general expenses, incidental and administrative costs whatsoever related to the change including, but not limited to, costs relating to superintendence and supervision, general cleanup, *Shop Drawing* production, estimating, site office and head office expenses and personnel, administration costs, workers' tools, temporary facilities and controls, record drawings, *As-Built Drawings*, use of scheduling and modelling software, warranty, insurance, bonding, job safety costs, and coordination of any and all *Work*-related activities.

6.2.5 No claim whatsoever for a change in the *Contract Time*, delay, prolongation charges, remobilization or otherwise shall be permitted with respect to a change, unless first authorized by the *Consultant* and approved by the *Owner* and set out in a *Change Order*. For certainty, an adjustment to the *Contract Time* will be considered only when the *Contractor* demonstrates to the *Owner* that a change in the *Work* affects the critical path of the *Work*. Any costs associated with an adjustment to the *Contract Time* shall be identified by the *Contractor* and shall be limited to the reasonable direct costs directly attributable to the adjustment to the *Contract Time*.

6.2.6 The *Contractor* shall not be entitled to any additional compensation or an adjustment to the *Contract Time* arising out of changes to the *Work* aside from the amounts stated in a *Change Order*. In no event shall the *Owner* be liable to the *Contractor* for any costs, including indirect, impact or consequential costs, arising out of changes to the *Work* beyond the agreed upon amount of the *Change Order*."

SC 3.30 GC 6.3 CHANGE DIRECTIVE

3.30.1 Amend paragraph 6.3.7 by inserting the words "Subject to paragraph 6.3.14," at the beginning.

3.30.2 Amend paragraph 6.3.12 by inserting the following to the beginning:

"An adjustment to the *Contract Time* will be considered only where the change affects the critical path of the *Work*."

3.30.3 Add a new paragraph 6.3.14 as follows:

"6.3.14 Without limitation, the following shall not form part of the cost of performing the work attributable to a *Change Directive*, and shall not be recoverable by the *Contractor*:

.1 head office salaries and benefits and all other overhead or general expenses, except only for the amounts described in paragraph 6.3.7.1;

.2 capital expenses and interest on capital;

.3 general clean-up, except where the performance of the work attributed to the *Change Directive* causes specific additional clean-up requirements;

.4 wages paid for field supervision of *Subcontractors* and *Suppliers* and for project managers, assistants, watch persons and administrative personnel;

.5 wages, salaries, rentals or other expenses that exceed the rates that are standard in the locality of the *Place of the Work* or that are otherwise deemed unreasonable by the *Consultant*;

.6 costs or expenses attributable to the negligence, improper work, deficiencies, or breaches of contract by the *Contractor* or any *Subcontractor* or *Supplier*;

.7 costs of quality assurance, such as inspection and testing services, charges levied by authorities having jurisdiction, and any legal fees unless any such costs or fees are pre-approved in writing by the *Owner*; and

.8 the costs of the items listed in paragraph 6.2.4 of GC 6.2 – CHANGE ORDER."

SC 3.31 GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

3.31.1 Add a new paragraph 6.4.0 as follows:

"6.4.0 The *Contractor* confirms that, before signing this *Contract*, it carefully investigated and examined the *Place of the Work*, the *Contract Documents* and any other documents made available by the *Owner*, and has satisfied itself as to the conditions, circumstances, limitations and requirements necessary for the *Contractor* to perform the *Work* in accordance with the *Contract Documents*. No allowances will be made for additional costs and no claims by the *Contractor* will be considered for an adjustment in the *Contract Price* or *Contract Time* in connection with conditions which were reasonably apparent or which could reasonably have been discovered before the signing of this *Contract*."

3.31.2 Amend paragraphs 6.4.1.1 and 6.4.1.2 by adding the following to the end of each paragraph:

"and which were concealed from discovery notwithstanding the conduct of the investigations and examinations described in paragraph 6.4.0."

SC 3.32 GC 6.5 DELAYS

3.32.1 Amend paragraph 6.5.1 by deleting the last sentence and replacing it with the following:

"The *Contractor* shall be reimbursed by the *Owner* for reasonable direct costs directly flowing from the delay, but excluding all *Unrecoverable Costs*."

3.32.2 Amend paragraph 6.5.2 by deleting the last sentence and replacing it with the following:

"The *Contractor* shall be reimbursed by the *Owner* for reasonable direct costs directly flowing from the delay, but excluding all *Unrecoverable Costs*. Provided that this paragraph 6.5.2 shall not apply where the stop work order is issued as a result of a declaration of a state of emergency or the occurrence of an epidemic or pandemic, in which case any resulting delay shall be governed by paragraph 6.5.3."

3.32.3 Amend paragraph 6.5.3 as follows:

(a) add a new subparagraph 6.5.3.0 as follows:

"6.5.3.0 acts, orders, legislation, regulations or directives of any court, government or other public authority, including stop work orders or *Project* closures or suspensions, made or issued as a result of a declaration of a state of emergency or the occurrence of an epidemic or pandemic,"

(b) add a new subparagraph 6.5.3.5 as follows:

"6.5.3.5 demonstrations and protests including, but not limited to, native protests, sit-ins, blockages, riots, insurrections and uprisings,"

3.32.4 Amend paragraph 6.5.4 by adding the following to the end:

"For certainty:

.1 the fact there may be a discussion of or relating to delay during a meeting or the fact delay may be mentioned in minutes of meetings does not constitute *Notice in Writing* of the cause of delay nor an effective notice of delay; and

.2 it is the intention of the parties that an extension for delay will be considered only when the *Contractor* demonstrates that the delay affects the critical path of the *Work* and that reasonable mitigation efforts have been attempted to reduce the delay and the costs associated therewith, and any adjustment to the *Contract Time* shall only be to the extent that the critical path of the *Work* is affected."

3.32.5 Add new paragraphs 6.5.6 to 6.5.8 as follows:

"6.5.6 The *Contractor* acknowledges and agrees that the *Owner* shall not be liable for any delay or part thereof that occurs concurrently with an independent cause of delay for which the *Owner* is not responsible. In addition, in the event the *Owner* is responsible for two or more separate causes of delay that run in whole or in part parallel to each other, those two or more events shall be considered as one for the purpose of determining the duration of the extension of the *Contract Time* and/or any amount payable to the *Contractor*.

6.5.7 The *Contractor* shall be responsible for the care, maintenance and protection of the *Project* in the event of any suspension of the *Work* as a result of the delay described in paragraphs 6.5.1, 6.5.2 and 6.5.3 and shall be reimbursed by the *Owner* for the reasonable direct costs incurred by the *Contractor* for such care, maintenance and protection, but excluding the *Contractor's* head office personnel and overhead costs.

6.5.8 If the *Contractor* is delayed in the performance of the *Work* by an act or omission of the *Contractor* or anyone directly or indirectly employed or engaged by the *Contractor*, or by any cause within the *Contractor's* control, then:

.1 the *Contractor* shall, at the *Contractor's* own expense, make best efforts to minimize the delay, including working extended shifts or weekends; and

.2 the *Contract Time* shall be extended for such reasonable time as the *Consultant* may decide in consultation with the *Owner*.

In addition, the *Contractor* shall reimburse the *Owner* for all reasonable costs and expenses incurred by the *Owner* as a result of the delay including, but not limited to, the costs of additional services required by the *Owner* from the *Consultant* or any other consultants, project managers, contractors, or others employed or engaged by the *Owner*."

SC 3.33 GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

3.33.1 Delete paragraph 7.1.2 and replace it with the following:

"7.1.2 If the *Contractor* neglects to prosecute the *Work* properly, or fails or neglects to maintain the construction schedule, or otherwise fails to comply with the requirements of the *Contract* to a material extent, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, notify the *Contractor* in writing that the *Contractor* is in default of the *Contractor's* contractual obligations and instruct the *Contractor* to correct the default in the 5 *Working Days* immediately following the receipt of such notice, but without affecting in any respect the liability of the *Contractor* in respect of earlier defaults."

3.33.2 Add a new paragraph 7.1.5A as follows:

"7.1.5A If the *Owner* terminates the *Contractor's* right to continue with the *Work* in whole or in part or terminates the *Contract* as provided in this GC 7.1, the *Contractor* shall deliver to the *Owner*, within 5 days of the effective date of the termination, all of the materials listed in paragraph 12.1.1 of GC 12.1 – READY-FOR-TAKEOVER in the possession of or available to the *Contractor*."

3.33.3 Add a new paragraph 7.1.7 as follows:

"7.1.7 The *Owner* may terminate this *Contract* for convenience at any time for any or no reason by giving written notice to the *Contractor*. In such event, the *Owner* shall pay for the *Work* performed up to the effective date of termination, including demobilization costs, and for such additional reasonable direct costs, if any, directly flowing from and which are a reasonable consequence of the termination, but excluding all *Unrecoverable Costs*. The *Owner* shall not be liable to the *Contractor* for any other claims, costs or damages whatsoever arising from such termination of this *Contract*."

SC 3.34 GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

3.34.1 Amend paragraph 7.2.2 by deleting "20 *Working Days*" in the first line and replacing it with "40 *Working Days*."

3.34.2 Amend paragraph 7.2.3 as follows:

(a) delete paragraphs 7.2.3.1 and 7.2.3.2;

(b) delete paragraphs 7.2.3.3 and 7.2.3.4 and replace them with the following:

"7.2.3.3 the *Owner* fails to pay the *Contractor* when due the amount certified by the *Consultant* or awarded by arbitration or a court; provided that this paragraph shall not apply to the *Owner's* withholding of payments in accordance with the *Contract Documents*, or

7.2.3.4 the *Owner* violates the requirements of this *Contract* to a substantial degree, and the *Consultant* gives a written statement to the *Owner* and the *Contractor* that provides details of such violation and confirms to the *Contractor* and the *Owner* that sufficient cause exists to justify the *Contractor's* action."

3.34.3 Amend paragraph 7.2.4 by deleting "5" in the second line and replacing it with "10".

3.34.4 Delete paragraph 7.2.5 and replace it with the following:

"7.2.5 If the default cannot be corrected within the 10 *Working Day*s specified in paragraph 7.2.4, the *Owner* shall be deemed to have cured the default if it:

.1 commences the correction of the default within the specified time; and

.2 provides the *Contractor* with a reasonable schedule for such correction; and

.3 completes the correction in accordance with such schedule.

7.2.6 If the *Contractor* terminates the *Contract* under the conditions described in this GC 7.2, the *Contractor* shall ensure the *Work* and the *Place of the Work* are left in a safe and secure condition as required by authorities having jurisdiction and the *Contract Documents*, and shall be entitled to be paid for all *Work* performed to the date of termination together with the costs directly flowing from and which are a reasonable consequence of the termination, but excluding all *Unrecoverable Costs*. The *Owner* shall not be liable to the *Contractor* for any other claims, costs or damages whatsoever arising from such termination of the *Contract*."

SC 3.35 GC 9.1 PROTECTION OF WORK AND PROPERTY

3.35.1 Amend paragraph 9.1.1.1 by adding the following to the end:

"which the *Contractor* could not reasonably have discovered applying the degree of care and skill described in this *Contract*;"

3.35.2 Amend paragraph 9.1.2 by deleting the words "reasonably apparent in" from the second line and replacing them with "reasonably discoverable from".

3.35.3 Add a new paragraph 9.1.5 as follows:

"9.1.5 Without in any way limiting the *Contractor*'s obligations under this GC 9.1, should the *Contractor* or any *Subcontractor* or *Supplier* cause loss or damage to property, including roads, buildings, structures, paving, grass, sod, trees or other plantings, whether owned by the *Owner* or others, and whether at the *Place of the Work* or adjoining it, the *Contractor* shall be liable for the cost of making good such damage and for the repair and any replacement cost of the grass, sod, trees or other plantings damaged, including the cost of any arborist or other consultant, and such costs may be deducted by the *Owner* from amounts otherwise owing to the *Contractor*. If there is no amount owing by the *Owner* to the *Contractor* at that time, then the *Contractor* shall reimburse the *Owner* for all of the said costs."

SC 3.36 GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

3.36.1 Amend paragraph 9.2.3 by deleting the words "The *Owner*" in the first line and replacing them with "The *Contractor*".

3.36.2 Amend paragraph 9.2.4 by deleting the words "Unless the *Contract* expressly provides otherwise, the *Owner*" in the first line and replacing them with "The *Contractor*".

3.36.3 Add new paragraphs 9.2.5.5 and 9.2.5.6 as follows:

"9.2.5.5 take all reasonable steps necessary to mitigate or stabilize any conditions resulting from encountering toxic or hazardous substances, and

9.2.5.6 take all necessary steps to mitigate the impact on *Contract Time* and *Contract Price*."

3.36.4 Amend paragraph 9.2.7.3 by adding the words ", but excluding all *Unrecoverable Costs*" after the words "as a result of the delay" at the end of the second line.

3.36.5 Amend paragraph 9.2.8 by adding the following after the word "responsible," in the second line:

"or that any toxic or hazardous substances 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,"

3.36.6 Add new paragraphs 9.2.10 and 9.2.11 as follows:

"9.2.10 The *Contractor* shall, immediately upon becoming aware of any environmentally toxic and hazardous substance or materials (within the meaning of applicable environmental legislation), notify the *Owner* in writing setting out particulars concerning the type of the environmentally toxic and hazardous substance or materials, where it was discovered, and all other information that the *Contractor* has at the time of the notice.

9.2.11 The *Contractor* shall indemnify the *Owner* and its manager, officers, directors, employees, agents and elected officials in respect of any loss, costs, expense or fine which might be imposed in respect of any failure by the *Contractor* to satisfy its obligations under this GC 9.2 and, without limiting the general nature of this indemnity, the *Contractor* shall indemnify the *Owner* and its manager, officers, directors, employees, agents and elected officials in respect of any loss, costs, expense or fine if the *Project* is made subject to an order from a court or government agency requiring remediation of any contamination caused as a result of the *Work* performed by the *Contractor* or its *Subcontractors* or *Suppliers*."

SC 3.37 GC 9.4 CONSTRUCTION SAFETY

3.37.1 Delete paragraph 9.4.5.

3.37.2 Add new paragraphs 9.4.6 to 9.4.9 as follows:

"9.4.6 The *Contractor* represents and warrants that it is an experienced contractor and has extensive experience and expertise with respect to compliance with the requirements and obligations of the *OHSA* in performing the *Work*, and acknowledges that the *Owner* relied on such representation and warranty in selecting the *Contractor* to perform the *Work* and in entering into this *Contract*.

9.4.7 Without limiting the generality of paragraph 9.4.1, the *Contractor* shall be and shall assume all of the responsibilities of the "constructor" under *OHSA* for the *Project* and shall file the "Notice of Project" with the appropriate government agency naming the *Contractor* as the "constructor" for the *Project*.

9.4.8 The *Contractor* shall be solely and exclusively responsible for controlling the workplace and the *Place of the Work* and shall take all steps to effectively direct and supervise the *Work* in order to ensure conformity and compliance with *OHSA* and all other applicable construction health and safety requirements, regulations, industry standards and guidelines, including COVID-19 protocols for construction sites and any applicable *Owner* handbooks, guides, protocols or requirements. The *Contractor* represents and warrants to the *Owner* that appropriate health and construction safety instruction and training have been provided and will be provided to the *Contractor's* employees, *Subcontractors*, *Suppliers* and all others attending at the *Place of the Work*, including the *Owner's* representatives, the *Owner's* own forces, and *Other Contractors*. No comments, suggestions or instructions from the *Owner*, the *Consultant* or any other representative of the *Owner* are to be relied upon or assumed to reduce or replace the

Contractor's designation as the "constructor" or its responsibility for construction safety on the *Project*.

9.4.9 The *Contractor* shall indemnify and save harmless the *Owner* and its manager, officers, directors, employees, agents and elected officials, as well as the *Owner's* consultants, successors and assigns, from and against any and all liability, costs, expenses, charges, fines, damages and all other consequences arising from any and all safety infractions on the *Project*, including the payment of legal fees and disbursements on a full indemnity basis."

SC 3.38 GC 9.5 MOULD

3.38.1 Amend paragraph 9.5.2.3 by adding the words "and for any delay" immediately before the comma near the end.

3.38.2 Amend paragraph 9.5.3.3 by adding the words ", but excluding all *Unrecoverable Costs*" after the words "as a result of the delay".

SC 3.39 GC 10.1 TAXES AND DUTIES

3.39.1 Amend paragraph 10.1.2 by adding the following to the end:

"For greater certainty, the *Contractor* shall not be entitled to any mark-up for overhead or profit on any increase in such taxes and duties."

3.39.2 Add new paragraphs 10.1.3 to 10.1.6 as follows:

"10.1.3 If the *Owner* is entitled to an exemption or a recovery of sales taxes, customs duties, excise taxes or *Value Added Taxes* applicable to the *Contract*, the *Contractor* shall, at the request of the *Owner*, assist with the application for any exemption, recovery or refund of all such taxes and duties and all amounts recovered or exemptions obtained shall be for the sole benefit of the *Owner*. The *Contractor* agrees to endorse over to the *Owner* any cheques received from the federal or provincial governments, or any other taxing authority, as may be required to give effect to this paragraph.

10.1.4 The *Contractor* shall maintain accurate records of equipment, material and component costs reflecting the sales taxes, customs duties, excise taxes and *Value Added Taxes* paid.

10.1.5 Any refund of taxes including, without limitation, any government sales tax, customs duty, excise tax or *Value Added Tax*, whether or not paid, which is found to be inapplicable or for which exemption may be obtained, is the sole and exclusive property of the *Owner*. The *Contractor* agrees to cooperate with the *Owner* and to cause all *Subcontractors* and *Suppliers* to cooperate with the *Owner* in the application for any refund of any taxes, which cooperation shall include, but not be limited to, making or concurring in the making of an application for any such refund or exemption and providing to the *Owner* copies, or where required, originals of records, invoices, purchase orders and other documentation necessary to support such applications or exemptions or refunds. All such refunds shall either be paid to the *Owner* or shall be a credit to the *Owner* against the *Contract Price*, in the *Owner's* discretion.

10.1.6 Customs duties and penalties or any other penalty, fine or assessment levied against the *Contractor* shall not be treated as a tax or customs duty for purposes of this GC 10.1."

SC 3.40 GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

3.40.1 Amend paragraph 10.2.4 by adding the following to the end:

"and shall be present at each site inspection by an inspector or registered code agency."

3.40.2 Amend paragraph 10.2.5 by deleting "The" at the beginning and replacing it with the words "Subject to paragraph 1.1.12 of GC 1.1 – CONTRACT DOCUMENTS, the".

3.40.3 Amend paragraph 10.2.6 as follows:

(a) delete the words "performs work knowing it to be" and replace them with "performs work when it knew or ought to have known that such work is"; and

(b) delete the words “bear the” in the third line and replace them with “indemnify and save the *Owner* harmless against all”.

3.40.4 Amend paragraph 10.2.7 by adding the following to the end:

“, provided that any claims arising from any delays due to such changes will be dealt with in accordance with GC 6.5 – DELAYS.”

SC 3.41 GC 11.1 INSURANCE

3.41.1 Delete GC 11.1 in its entirety and replace it with the following:

“**GC 11.1 INSURANCE**

11.1.1 The *Contractor* shall obtain, maintain, pay for and provide to the *Owner* evidence of the insurance coverage required under this *Contract*. Any deductible and/or self-insured retention are the responsibility of the *Contractor* and shall not constitute a *Project* expense chargeable back to the *Owner* in any way.

.1 Commercial General Liability Insurance

General liability insurance shall be maintained from the date of commencement of the *Work* until one year from the date of *Ready-for-Takeover*. Liability coverage shall be provided for completed operations hazards from the date of *Ready-for-Takeover*, as set out in the certificate of *Ready-for-Takeover*, on an ongoing basis for a period of 6 years following *Ready-for-Takeover*

Commercial General Liability, underwritten by an insurer licensed to conduct business in the Province of Ontario, for a limit of not less than $5,000,000 per occurrence, an aggregate limit of not less than $10,000,000, within any policy year with respect to completed operations and a deductible of not more than $50,000. The insurance coverage shall not be less than the insurance provided by IBC Form 2100 and IBC Form 2320. The policy shall include an extension for a standard provincial and territorial form of non-owned automobile liability policy. This policy shall include but not be limited to:

.1 Name the *Owner* as an additional insured;

.2 Cross-liability and severability of interest;

.3 Blanket Contractual;

.4 Products and Completed Operations;

.5 Premises and Operations Liability;

.6 Personal Injury Liability;

.7 Contingent Employers Liability;

.8 Owners and Contractors Protective;

.9 Broad Form Property Damage;

.10 Firefighting Expenses;

.11 Elevator and Hoist Liability;

.12 Attached Machinery – while loading and unloading

The following also applies:

a) If applicable to the *Project*, coverage shall include shoring, blasting, excavation, underpinning, demolition, pile driving, caisson work and work below ground surface including tunneling and grading.

c) If the *Work* involves the use or operation of an owned or non-owned manned aircraft or watercraft, the policy shall provide coverage for this exposure.

d) To achieve the desired limits, umbrella or excess liability insurance may be used.

e) The *Owner* reserves the right to request in addition to Commercial General Liability Insurance coverage Wrap-up Liability. The Wrap-up shall be in the names of the *Owner*, *Contractor*, all *Subcontractors*, the *Consultant* and all other architects, engineers, consultants, planners and project managers. Limits and coverages shall comply with the requirements outlined above.

.2 Automobile Insurance

Standard Form Automobile Liability Insurance that complies with all requirements of the current legislation of the Province of Ontario, having an inclusive limit of not less than $5,000,000 per occurrence for third party liability, in respect of the use or operation of vehicles owned, operated or leased by the *Contractor*.

.3 Builders Risk Insurance

Broad Form Builders' Risk Insurance written in the joint names of the *Contractor, Owner*, *Subcontractors*, and underwritten by an insurer licensed to conduct business in the Province of Ontario. The policy shall have limits of not less than 1.1 times the *Contract Price*. Should the *Owner* provide any property to be incorporated into the *Project*, the policy must be endorsed to include the *Owner's* property. Coverage shall be maintained during the term of the *Contract* and until 10 calendar days after the date of *Ready-for-Takeover*.

The Builders' Risk policy shall:

.1 Be endorsed to grant permission to occupy prior to the completion or acceptance of the entire *Work*.

.2 Not be less that the insurance coverage provided by IBC Forms 4042 and 4047 or their equivalent replacement.

.3 Include the installation, testing, commissioning and subsequent use of any machinery and equipment including boilers, pressure vessels or vessels under vacuum.

.4 Apply to all *Products*, labour, equipment and supplies of every nature, the property of the *Owner* or *Contractor* or for which the *Owner* or *Contractor* may have assumed responsibility (whether on site or in transit), that is to be used in or pertaining to site preparation, erection, fabrication, construction or reconstruction of the structure.

.5 Be subject to a waiver of coinsurance.

.6 Include coverage for materials while in transit, awaiting installation or stored at off-site locations. Coverage shall be in an amount equal to the value of the material.

.7 Provide that in the case of a loss or damage payment shall be made to the *Owner* and the *Contractor* as their respective interests may appear. The *Contractor* shall act on behalf of the *Owner* for the purpose of adjusting the amount of such loss or damage payment with the insurer. When the extent of the loss or damage is determined, the *Contractor* shall proceed to restore the *Work*. Loss or damage shall not affect the rights and obligations of either party under the *Contract* except that the *Contractor* shall be entitled to a reasonable extension of *Contract Time*.

.4 Boiler and Machinery Insurance

The Boiler and Machinery Policy shall be written in the joint names of the *Contractor*, *Owner* and *Subcontractors* and underwritten by an insurer licensed to conduct business in the Province of Ontario. The policy limit shall equal the replacement value of all permanent or temporary boilers and pressure vessels and other insurable objects forming part of the *Work*. The *Contractor* may elect to carry the testing, commissioning and subsequent use of these objects under the Boiler and Machinery Policy.

.5 Contractor's Equipment Floater

The *Contractor* shall provide and maintain coverage for all equipment used on the *Project* during the term of this *Contract*. Coverage will be provided, on a broad form basis, for construction machinery, equipment, tools and stock that will be used by the *Contractor* in the performance of the *Work.* The coverage will also include rental expense. Coverage is to be carried from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.

.6 Contractor's Pollution Liability

The *Contractor* shall carry a Contractor's Pollution Liability Policy, underwritten by an insurer licensed to conduct business in the Province of Ontario for a limit of not less than $2,000,000. Coverage shall include bodily injury, property damage, clean-up and remediation costs.

.7 Wrap-Up Liability Insurance

Wrap-up Liability, underwritten by an insurer licensed to conduct business in the Province of Ontario, for a limit of not less than $10 million per occurrence. The Wrap-up shall be in the joint names of the Owner, Contractor, all Sub-contractors, Architects, Engineers, Consultants and Project Managers. The policy will be carried from the date of commencement of the work until 24 months from the date of Substantial Performance of the Work. The insurance coverage shall not be less than the insurance provided by IBC Form 2100 and IBC Form 2320. The policy shall include an extension for a standard provincial and territorial form of non-owned automobile liability policy. This policy shall include but not be limited to:

(a) Cross-liability and severability of interest

(b) Blanket Contractual

(c) Products and Completed Operations

(d) Premises and Operations Liability

(e) Personal Injury Liability

(f) Contingent Employers Liability

(g) Owners and Contractors Protective

(h) Broad Form Property Damage

(i) Firefighting Expenses

(j) Elevator and Hoist Liability

(k) Attached Machinery – while loading or unloading

The following may apply:

a) If applicable to the construction project described in the Agreement, coverage shall include shoring, blasting, excavation, underpinning, demolition, pile driving, caisson work and work below ground surface including tunneling and grading.

All insurance policies, required by the Proponent, shall be primary and not additional to or contributing with any other insurance carried by or for the municipality.

.8 Proof of Insurance

.1 The *Contractor* shall provide the *Owner* with an executed certificate of insurance and a renewal replacement as may be necessary, stating any pertinent exclusions as applicable contained in the policies which may affect coverage as outlined in this *Contract*. The certificate will be delivered prior to the commencement by the *Contractor* of the *Work* or upon renewal of the policy. The *Contractor's* insurance carriers and the insurance policy provisions must be acceptable to the *Owner*. All lines of coverage required by this *Contract* must be shown on the certificate of insurance. The *Contractor* will make available complete certified copies of all applicable insurance policies for examination if required by the *Owner*.

.2 The *Contractor* shall ensure that each *Subcontractor* requires adequate insurance in accordance with the work being performed under the terms of their engagement. It is the *Contractor's* responsibility to ensure this exposure is insured adequately and at no time will costs associated with this exposure be transferred to the *Owner*.

.3 Delivery to and examination or approval by the *Owner* of any certificates of insurance or policies of insurance or other evidence of insurance shall not relieve the *Contractor* of any of its indemnification or insurance obligations under this *Contract*. The *Owner* shall be under no duty to either ascertain the existence of or to examine such certificate of insurance or policies of insurance or to advise the *Contractor* in the event that such

insurance coverage is not in compliance with the requirements set out in this *Contract*. The *Contractor* is responsible for ensuring such compliance.

.9 All policies of insurance shall:

.1 Be recorded as being a primary policy and shall be in a form and issued by an insurance company satisfactory to the *Owner* and that is licensed to carry on business in Ontario;

.2 Be maintained continuously during the course of the *Work* or for such period of time as may be required after completion of the *Work* as may be deemed necessary by the *Owner*;

.3 The *Contractor* shall ensure that any self-insured and deductible limits are prudent and responsible for the type of work being undertaken under the *Contract*. Any and all claim costs are borne by the *Contractor* including, but not limited to, deductibles, adjusting fees, legal costs, disbursements, and settlements;

.4 Ensure that, except in the case of automobile liability insurance, non-owned automobile liability insurance, the *Owner* is to be added to the policy as an additional insured and/or loss payee;

.5 Contain a cross-liability and severability of interest provisions, as may be applicable;

.6 Provide that at least thirty (30) days prior written notice, fifteen (15) days in the case of automobile liability insurance, and ten (10) days in the event of non-payment of premiums, shall be given to the *Owner* by the insurer before the insurer or the *Contractor* takes any steps to cancel, terminate, fail to renew, amend or otherwise change or modify the insurance or any part thereof.

.7 Necessary notification to insurers is required to ensure continuous coverage is in place at all times. This will include, but is not limited to, transfer of coverage from one policy to another (i.e. completion of a building constructed under a Builder's Risk Policy being transferred to a Property policy once *Ready-for-Takeover* has been attained)."

SC 3.42 GC 12.1 READY-FOR-TAKEOVER

3.42.1 Delete paragraphs 12.1.1.4 and 12.1.1.5 and replace them with the following:

"12.1.1.4 The delivery to the *Owner* of guarantees, warranties, certificates, testing and balancing reports and spare parts, distribution system diagrams, *Shop Drawings*, maintenance and operating manuals, instructions, samples, existing reports and correspondence from authorities having jurisdiction, and all other close-out materials or documents specified in the *Contract Documents*.

12.1.1.5 The delivery to the *Owner* of the *As-Built Drawings* acceptable to the *Consultant* showing the *Work* completed to date."

3.42.2 Delete paragraph 12.1.2 and replace it with the following:

"12.1.2 If any of the prerequisites set forth in paragraphs 12.1.1.3 to 12.1.1.6 are deferred by agreement between the *Owner* and the *Contractor*, *Ready-for-Takeover* shall not be delayed. To be effective, such agreement shall be in writing and shall be signed by both parties."

3.42.3 Amend paragraph 12.1.5 by adding the following to the end:

", which shall be no later than thirty (30) days after *Ready-for-Takeover*."

3.42.4 Delete paragraph 12.1.6.

SC 3.43 GC 12.2 EARLY OCCUPANCY BY THE OWNER

3.43.1 Delete paragraphs 12.2.1 through 12.2.4 and replace them with the following:

"12.2.1 The *Owner*, its agents, and *Other Contractors* shall have the right to enter, occupy, take possession of and/or use for any intended purpose any portion or all of the undelivered portion of the *Project*, even though *Ready-for-Takeover* may not have been attained, provided that such

entry, occupation, taking of possession or use will not interfere, in any material way, with the progress of the *Work*. The entry, occupation, taking of possession or use of any such portion of the *Project* or *Work* shall not be deemed to be the *Owner's* acknowledgement or acceptance of the *Work* or the *Project,* nor shall it be deemed to be an acknowledgment or acceptance by the *Owner* that such *Work,* or portions of the *Work,* have met the *Ready-for-Takeover* requirements, nor shall it entitle the *Contractor* to an adjustment to the *Contract Time* or *Contract Price*.

12.2.2 The *Contractor* shall, as directed by the *Consultant*, give priority to certain parts of the *Work* and bring such parts to a "ready for use" status. Such instructions may require installation of temporary stairs and exits and temporary services, all of which shall be provided and subsequently removed.

12.2.3 The *Contractor* shall maintain full access to the *Work* for the *Owner*'s use, as required. The *Contractor* shall maintain or restore heat and power to areas when necessary or as scheduled and keep existing utilities and services functional.

12.2.4 The entry, occupation, taking of possession or use of any portion of the *Project* by the *Owner*, its agents or *Other Contractors* pursuant to this GC 12.2 – EARLY OCCUPANCY BY THE OWNER shall not relieve the *Contractor* of any of its obligations under the *Contract*, including the *Contractor's* designation and obligations as "constructor" under *OHSA* and the *Contractor's* obligations respecting construction health and safety, and all of the *Contractor's* other obligations, rules, regulations and practices shall continue to apply notwithstanding such entry, occupation, taking of possession or use."

SC 3.44 GC 12.3 WARRANTY

3.44.1 Amend paragraph 12.3.1 by adding the following to the end:

"Notwithstanding the foregoing, if an item of *Work* is not completed at *Ready-for-Takeover*, except for extended warranties as described in paragraph 12.3.6, the warranty period for such item of *Work* shall be one year from the date that such item of *Work* has been completed and accepted in writing by the *Owner*."

3.44.2 Amend paragraph 12.3.2 by adding the following to the end:

"If the *Contractor* has been permitted to make use of permanent equipment or systems, as provided in GC 3.12 – CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS, such permanent equipment or systems shall be subject to the same warranty as described in this GC 12.3 and shall be judged, for purposes of assessing compliance with the warranty, as though the equipment or systems were new, clean and unused by the *Contractor*, except for normal commissioning and start-up activities."

3.44.3 Amend paragraph 12.3.4 by adding the following to the end:

"The *Contractor* shall perform all remedial and warranty work at its own cost and expense and at a time convenient to the *Owner*, which may be outside of normal working hours. Before performing the remedial and warranty work the *Contractor* shall provide, for the *Owner's* review and approval, a proposed schedule for the performance of such work. Except for any extended warranties provided for in the *Contract Documents*, the warranty period for any corrective work performed by the Contractor pursuant to GC 12.3 – WARRANTY shall commence on the date that such corrective *Work* was completed."

3.44.4 Add new paragraphs 12.3.5A and 12.3.5B immediately after paragraph 12.3.5 as follows:

"12.3.5A If the *Contractor* fails to perform the remedial and warranty work and/or fails to correct the defects, deficiencies or items of non-compliant *Work* or is not diligently working towards completion of the same to the satisfaction of the *Consultant*, or if the *Contractor* fails to correct or pay for damage resulting from corrections made, as required in paragraph 12.3.5, the *Owner* may engage others to perform the work necessary to complete the remedial and warranty work and to correct the outstanding defects, deficiencies or items of non-compliant *Work* and to correct damage resulting from corrections made, all at the risk and cost of the *Contractor*, and the *Owner* may deduct all costs and may pay for all damages incurred from the *Deficiency Rectification Security*. If the costs and damages incurred by the *Owner* exceed the amount of the *Deficiency Rectification Security*, the *Contractor* shall reimburse the *Owner* for all excess costs and damages. The *Owner's* rights under this paragraph are in addition to any other rights the *Owner* may have pursuant to the *Contract* and/or at law.

12.3.5B Provided that the *Contractor* has completed all outstanding remedial and warranty work and has corrected all defects and deficiencies and has completed all items of non-compliant *Work* and has corrected or paid for all damage resulting from corrections made, all to the satisfaction of the *Consultant*, the *Owner* shall return to the *Contractor* the remaining balance of the *Deficiency Rectification Security*, if any, without interest, thirty (30) days after the date that is the later of (a) the date of total completion of the *Contract*, and (b) the date on which the warranty period ends."

SC 3.45 GC 13.1 INDEMNIFICATION

3.45.1 Delete GC 13.1 and replace it with the following:

"13.1.1 The *Contractor* shall indemnify and shall defend and save harmless the *Owner*, its manager, officers, directors, agents, representatives, elected officials, successors, and employees harmless from and against any claims, causes of action, demands, losses, charges, fees, duties, accounts, fines, penalties, expenses and costs (including legal costs on a solicitor and client basis), or other proceedings of every kind or nature whatsoever at law or in equity brought against, suffered by, or imposed on the reason of,

.1 the *Contractor* carrying out or failing to carry out any obligation to which it is subject including the performance of the *Work*, or exercising any right to which it is entitled, under the *Contract* except to the extent that the same are caused by the negligence or deliberate wrong-doing of the *Owner* or other person entitled to indemnification under this section, or

.2 any patent, trademark, copyright infringement or other breach of any intellectual property right of any person, for which the *Contractor* or any *Subcontractor* to the *Contractor* is responsible.

13.1.2 The *Contractor* shall indemnify and hold harmless the *Owner's* agents and employees from and against 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 attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property, and caused by negligent acts or omissions of the *Contractor* or anyone for whose acts the *Contractor* may be liable, and made in writing within a period of 6 years from the date of *Ready-for-Takeover* as set out in the certificate of *Ready-for-Takeover*, or within such shorter period as may be prescribed by any limitation statute or the province or territory of the *Place of the Work*."

SC 3.46 PART 14 – OTHER PROVISIONS

3.46.1 Add a new "**PART 14 – OTHER PROVISIONS**" as follows:

"**PART 14 OTHER PROVISIONS**

GC 14.1 LIENS AND ACTIONS

14.1.1 The *Contractor* shall save and keep the *Owner* and the *Place of the Work* free from all construction liens and all other liens whatsoever arising out of the *Work*. If any lien is claimed, filed or registered or any written notice of a lien is received by reason of any *Work* supplied or claimed to have been supplied by or through a *Subcontractor* or *Supplier*, the *Contractor* shall, at its own expense, within ten (10) *Working Days* of being notified of the lien or written notice of a lien, secure the discharge, release, vacating or withdrawal of such lien or written notice of a lien by payment or by giving security or in such other manner as is or may be required or permitted by law, failing which the *Owner* may, but shall not be required, take such steps as it, in its absolute discretion, may deem necessary to release, vacate or discharge the lien or written notice of a lien.

14.1.2 If a lien action is commenced arising out of a lien described in paragraph 14.1.1, the *Contractor* shall take all reasonable steps to remove the *Owner* from such action and shall indemnify the *Owner* and hold it harmless in such action.

14.1.3 All amounts, including legal costs on a full indemnity basis, disbursements, interest, borrowing, premium or other bonding costs and/or charges incurred by the *Owner* in releasing, vacating, discharging and/or otherwise dealing with a *Subcontractor* or *Supplier* lien, written notice of a lien and/or defending or otherwise dealing with a lien action, shall be charged to the *Contractor* and shall be set off and deducted from any amount owing to the *Contractor*. If there is no amount

owing by the *Owner* to the *Contractor* at that time, then the *Contractor* shall reimburse the *Owner* for all amounts incurred by the *Owner*.

GC 14.2 OWNERSHIP OF MATERIALS

14.2.1 Unless otherwise specified, all materials existing at the *Place of the Work* at the time of execution of this *Contract* shall remain the property of the *Owner*. All *Products* delivered to the *Place of the Work* by the *Contractor* shall be the property of the *Owner* and shall be free of encumbrances. The *Contractor* shall remove all surplus or rejected materials from the *Place of the Work*.

GC 14.3 DAILY REPORTS/DAILY LOGS

14.3.1 The *Contractor* shall cause its supervisor, or such competent person as it may delegate, to prepare and maintain a daily site log or diary recording, at least, the following: (a) daily weather conditions and temperatures at the *Place of the Work*, (b) the number of workers of the *Contractor, Subcontractors, Suppliers* and any other forces at the *Place of the Work*, (c) the *Construction Equipment* at the *Place of the Work*, (d) the descriptions and quantities of *Products* delivered and utilized, and (e) the general nature of *Project* activities. Such log or diary shall also record any extraordinary or emergency events which may occur and also the identities of any persons who visit the *Place of the Work* who are not part of the day-to-day workforce. The *Contractor* shall also take or arrange for the taking of *Project* photographs to record the progress of the *Work*.

14.3.2 The *Contractor* shall maintain, either at its head office or at the *Project* site, records recording labour and material resourcing on the *Project*, including the records identified in paragraph 14.3.1 and other records which document the activities of the *Contractor*.

14.3.3 Upon request of the *Owner* or the *Consultant*, the *Contractor* shall make available for inspection and copying all of the records generated pursuant to this GC 14.3, along with any other routine *Project* records ordinarily maintained by the *Contractor*.

GC 14.4 ADVERTISING AND PUBLIC STATEMENTS

14.4.1 The *Contractor* shall not publish, issue or make any statements or news release, electronic or otherwise, concerning the *Contract*, the *Work*, or the *Project*, and shall not use the *Owner's* name or logo. without the prior express written consent of the *Owner*. For greater certainty, the *Contractor* shall obtain the prior written approval of the *Owner* for any public advertising, written public sales promotions, press release or other general publicity matter, in which the name or logo of the *Owner* is mentioned or used, or in which words are used from which any connection with the *Owner* may be inferred. The *Contractor* will not erect or permit the erection of any sign or advertising at the *Place of the Work* without the prior written approval of the *Owner*.

GC 14.5 AODA REQUIREMENTS

14.5.1 Pursuant to sections 7 and 80.49 of the Integrated Accessibility Standards Regulation, O. Reg. 191/11 (the "***Regulation***") under the *Accessibility for Ontarians with Disabilities Act, 2005* ("***AODA***"), the *Contractor* shall ensure that all of its employees, agents, volunteers, or others for whom it is at law responsible receive training about the provision of the goods and services contemplated herein to persons with disabilities. Such training shall be provided in accordance with sections 7 and 80.49 of the *Regulation* and shall include, without limitation, a review of the purposes of *AODA* and the requirements of the *Regulation*, as well as instruction regarding all matters set out in sections 7 and 80.49 of the *Regulation*. When requested by the *Owner*, the *Contractor* shall provide written proof that all employees have been trained as required under *AODA* as well as any documentation regarding training policies, practices and procedures.

GC 14.6 AMENDMENTS TO THE CONTRACT

14.6.1 Except for the written or e-mail direction referred to in paragraph 6.1.2 of GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, no alteration or amendment to this *Contract*, no course of conduct or dealing between the parties, and no express or implied acceptance of alterations or amendments to the *Contract* shall be binding unless it is in writing and signed by each party.

14.6.2 No waiver by or on behalf of a party of any breach of a provision of this *Contract* shall be binding upon the party unless it is expressed in writing and duly executed by the party or signed by its fully authorized representative, and such a waiver shall not operate as a waiver of any future breach, whether of a like or different character. No waiver shall be inferred from or implied by the conduct of any party.

GC 14.7 CONTRACT SECURITY

14.7.1 The *Contractor* shall deliver to the *Owner* a performance bond and a labour and material payment bond in the forms specified in the *Payment Legislation*, each in the amount of fifty percent (50%) of the *Contract Price* plus *Value Added Taxes.*

14.7.2 Such bonds shall be issued by a duly licensed surety company authorized to transact the business of suretyship in Ontario and shall be maintained in good standing until the fulfillment of the *Contract*. All premiums and other costs of the bonds are included in the *Contract Price*.

GC 14.8 LIQUIDATED DAMAGES

14.8.1 If the *Contractor* fails to attain *Ready-for-Takeover* by the date stipulated in paragraph 1.3 of Article A-1 of the Agreement – THE WORK, as such date may be adjusted in accordance with this *Contract* (the "***Required Ready-for-Takeover Date***"), the *Owner* may deduct the amount of $2,000.00 plus applicable HST as liquidated damages for each *Working Day* after the *Required Ready-for-Takeover Date* until *Ready-for-Takeover* is attained, up to a maximum amount of 5% of the *Contract Price*.

14.8.2 The parties agree that it would be extremely difficult to precisely determine the amount of actual damages that the *Owner* would suffer due to the *Contractor's* failure to attain *Ready-for-Takeover* by the *Required Ready-for-Takeover Date*, and agree that the liquidated damages amount in paragraph 14.8.1 is fair and reasonable having regard to the damages that would be suffered by the *Owner*, and that the liquidated damages amount does not constitute a penalty.

14.8.3 The *Owner* may invoice the *Contractor* for any amount due under this GC 14.8 or may deduct any amount due under this GC 14.8 from any monies that may be due or payable to the *Contractor* on any account whatsoever. The liquidated damages payable under this GC 14.8 are in addition to and without prejudice to any other remedy, action or other right that may be available to the *Owner*.

14.8.4 The parties irrevocably undertake that they will not, whether by legal proceedings or otherwise, contend that the liquidated damages provided in this GC 14.8 are not reasonable compensation, and the *Contractor* will not put the *Owner* to proof thereof, and neither party will contend that its agreement to such amounts and undertaking was arrived at by force, duress, coercion, mistake or misrepresentation on the part of the other party."

[Schedule of Key Personnel follows]

SCHEDULE – KEY PERSONNEL

The following are the *Key Personnel* assigned to the *Project*:

Name and Position	Employed By

The *Contractor* represents that the *Key Personnel* will be assigned to and will be dedicated to the *Project* on a full-time basis unless noted otherwise.

APPENDIX B – RFQ PARTICULARS

A. THE DELIVERABLES

The City of Brantford is seeking a qualified general contractor to construct a new Animal Shelter at 10 Kraemer's Way. The 7,500 sq. ft. one storey building will house and provide care for stray animals, care for sick or injured animals as well as provide other community services relating to animal control.

Completion Date

Kick-off meeting: November 12, 2024

Ready-for-Takeover: November 14, 2025

B. MATERIAL DISCLOSURES

- Geotech Investigation Report, as prepared by Englobe Corp., dated January 2018 is included at the end of the Specifications.
- City of Brantford Network Cabling Specifications, dated November 6, 2018
- City of Brantford Physical Security Standards, dated March 2024

The reports are included as part of the RFQ for information purposes. It is the respondent's responsibility to investigate the site conditions and ensure the site information is reflected in their contract price and that the work can be completed pursuant to the plans and specifications.

C. MANDATORY SUBMISSION REQUIREMENTS

1. Submission Form & Schedule of Prices

Each quotation must be submitted through the City's electronic Bidding System.

2. Other Mandatory Submission Requirements

N/A

D. MANDATORY TECHNICAL REQUIREMENTS

N/A

E. PRE-CONDITIONS OF AWARD

The selected respondent must satisfy the following conditions and provide the following information:

- A digital Labour & Material Payment e-bond provided on *Construction Act of Ontario (Form 31)* in an amount equal to 50% of the value of the contract price;
- A digital Performance e-bond provided on *Construction Act of Ontario (Form 32)* in an amount equal to 50% of the value of the contract price;

- Certificate of Insurance for the coverage and limits as set out in the agreement, naming The Corporation of the City of Brantford as additionally insured;
- WSIB clearance certificate confirming the Contractor is registered and has an account in good standing; and
- Notice of Project to the Ontario Ministry of Labour.

SCOPE OF SERVICES

1. PROJECT IDENTIFICATION

1.1 The work described within the Scope of Services relates to the official project ("the Project") known as Brantford Animal Shelter.

1.2 The project is located at 10 Kraemer's Way, Brantford, herein also referred to as the "project site". The project site is owned and managed by the Corporation of the City of Brantford, hereinafter also referred to as "the Owner" or "the City".

2. SCOPE OF SERVICES OVERVIEW

2.1. Located in the northwest of Brantford, the Brantford Animal Shelter will be constructed to house and be staffed to care for any stray dogs found at large, care for any sick or injured domestic animals, respond to all sick and injured wildlife concerns, and coordinate the removal of all deceased animals in the City of Brantford found on public property. The facility will provide space to run adoption programs, provide housing for quarantine animals when required and allow officers to perform animal control functions with bylaw enforcement.

2.2. The 7,500 sq. ft. one storey building will consist of a front lobby, general office/reception area, dog, cat and small pet adoption, dog and cat intake, dog and cat isolation, staff area including offices and kitchen, exam room, receiving bay and outside covered dog runs.

2.3. Cash Allowances: Testing and Inspections - $40,000.00

2.4. Provisional Prices:

2.4.1. No. 1 – Paw Print Signage on Exterior – as per drawing A302

2.4.2. No. 2 - Landscape Planting: 27 Privacy Shrubs around fencing - ToE/27 as per drawing L100

2.5. Separate Items:

2.5.1. No. 1 – Upgrade to Turf in Dog Run – as per division 31 92 00

2.5.2. No. 2 – Credit base contract for sheet vinyl and replace with supply and install of Epoxy flooring as per drawings A701 & A702 and specifications in the following rooms:

- Small Pet Intake – Room 106
- Cat Adoption – Room 107
- Cat Group Adoption – Room 108
- Dog Meet and Greet – Room 109
- Food Prep – Room 111
- Dog Adoption – Room 112
- Cat Intake – Room 125
- Cat Nursing – Room 126
- Cat Isolation – Room 128
- Dog Intake – Room 135
- Dog Isolation – Room 136

- Exam Room – Room 137

3. DETAILS OF THE SITE

3.1. The land at 10 Kraemer's Road is split into Part 1 owned by the Brant County SPCA, and Parts 2 and 4 owned by the City of Brantford. The Project will be built on Part 2 with asphalt laneway extended from the parking lot approximately 10' into Part 4 for future connection to the trails by others.

3.2. There are currently no other buildings on the land, however; the SPCA has future plans to build on Part 1.

3.3. Site plan approval and Building Permit have both been initiated and will be available to the successful bidder at commencement of the project.

4. GENERAL REQUIREMENTS

4.1 The Contractor is required to provide materials, labor, equipment and incidentals as necessary to complete the work described herein.

4.2 Cost for any health and safety requirements, including signage and protection shall be included in the contract price.

4.3 Contractor shall work with the City to ensure on-time completion and a high standard of professionalism is maintained to meet all relevant standards and warranty requirements.

4.4 Contractor shall verify field measurements to ensure that the proposed work described will be suitable for the existing site conditions and give recommendations for optimal installation and operation of such equipment.

4.5 Contractor shall include any necessary site or product modifications and adaptations to ensure a fully functioning turnkey system.

4.6 Contractor shall take immediate and necessary action to stop work and rectify any workmanship and materials that fail to meet the requirements identified within the Scope of Services.

4.7 Contractor shall provide prompt and reasonable response to all inquiries or complaints made via emails or phone call made by the City Project representative regarding the construction. In any event a response shall be made within 24 hours of initial report made by the City.

4.8 The Contractor is responsible for all utility and private locates prior to commencing work.

4.9 The Contractor shall support the City's policy to encourage and promote the 3-R's of material and energy consumption (reduce, reuse and recycle). The Contractor shall adhere to these same principles which includes but not limited to the following:

i. The work specified herein that will generate waste and debris and all such materials shall be disposed of at the Contractor's expense at an MOE-approved site in an MOE-approved manner.

ii. The Contractor shall provide certificates/documentation to confirm that disposal has been undertaken as per the contract. Where requested, such certificates shall be furnished prior to, and as a specific condition of, the City's final payment. Certificates shall state the location and date of the disposal site, that disposal has been completed satisfactorily, and that all applicable fees and permits have been paid.

5. DUTIES AND RESPONSIBILITIES

5.1 City Project Representative

a) A Project Manager from the City's Facilities Capital Development, Engineering Services Department has been appointed to coordinate the development of the Project. Responsibilities include, but are not limited to:

   i) Monitoring and exercising control and right of approval over the development of the Project,
   ii) Deciding on matters of deviation from the Project,
   iii) Communicating decisions and directions to the Consultant and Contractor,
   iv) Attending Contractor co-ordination meetings as necessary,
   v) Monitoring schedule, performance and safety practices,
   vi) Coordinating access to City property for Work required to complete the Project and liaising with Senior Management, and;
   vii) Completing progress payments for the Contractor.

b) All Project correspondence shall be directed through the assigned representative.

6. TENTATIVE PROJECT SCHEDULE

The Project Schedule is intended to provide anticipated completion dates in which the City is working toward. Notwithstanding the foregoing, the City reserves the right to modify the timelines set out below as the City deems necessary.

EVENT	**DATE**
Project Preconstruction Meeting	November 12, 2024
Shop Drawing Review and Mobilization to Site	November/December 2024
Ready for Take Over Date	**November 14, 2025**

7. PROTECTION OF WORK AND PROPERTY

7.1. The Contractor is responsible for any damage to any surrounding structures and vehicles. Any damage incurred shall be corrected by the Contractor at no additional cost to the City.

7.2. All work to be kept on paved / asphalt areas where possible. Should damage occur to any landscaping or sod due to construction, the Contractor shall be solely responsible to repair damage back to pre-construction state.

8. GUARANTEE & WARRANTY

8.1 Notwithstanding any warranties that may exist under law and/or as may be provided by the manufacturers of the components that are incorporated in the Work, provide a manufacturer's signed certificate warranting materials against any factors detrimental to appearance or performance under normal usage for a period of at least the manufacturers standard material warranty period or as otherwise provided in the specifications.

8.2 The Contractor is responsible for expeditious rectification in a manner satisfactory to the City, and for any related costs of any imperfect Work due to or arising from materials, equipment incorporated into or used in the construction, that is discovered by any means at any time during the 2 year period immediately following completion of the Project. The City shall decide as to the nature, extent, cause of, and responsibility for imperfect Work and the necessity for and the method of rectification thereof.

Project:

Brantford Animal Shelter

10 Kraemer's Way
Brantford, On N3V 0A5

ARCHITECTURAL SPECIFICATIONS
ROA Project ID: ROA23-003

ISSUED FOR: Bids **08-12-2024**

MM-DD-YEAR

work 519.397.0943
fax 519.480.0645

info@roastudio.com

ROA studio inc.
67 King Street West, Chatham ON N7M 1C7

www.roastudio.com

PART 1 - GENERAL

1.1 Geotechnical Report

.1 A copy of the Geotechnical Report is included.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not used.

END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

Construct the new Animal Shelter located at 10 Kraemer's Way and further identified as ROA studio Inc. Project ID 23-003.

1.2 CONTRACT METHOD

.1 Construct Work under single, stipulated price contract

1.3 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy of each document as follows:

- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Reviewed Shop Drawings.
- .5 List of Outstanding Shop Drawings.
- .6 Change Orders.
- .7 Other Modifications to Contract.
- .8 Field Test Reports.
- .9 Copy of Approved Work Schedule.
- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Other documents as specified

1.4 PERMITS

.1 The **Owner** shall obtain and pay for zoning revisions, permanent easements, rights of servitude, and building permit. The **Contractor** shall be responsible for all permits, including licenses, damage and other deposits including municipal right of ways, or certificates necessary for the performance of the Work which were in force at the date of bid closing.

1.5 CONTRACTOR USE OF PREMISES

.1 Limit access of construction personnel to areas of Work. Ensure construction personnel do not use occupied areas of the existing site, except where prearranged with Owner.

.2 Smoking is prohibited everywhere on the property.

.3 Contractor responsible for supplying porta-toilet for duration of construction.

.4 Secure work area by methods compatible with the total security established for the building.

.5 Contractor's forces, tradesmen, workers, suppliers of subcontractors employed directly or indirectly by the Contractor shall be allowed to park their vehicles in designated areas only.

.6 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.7 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.6 OWNER OCCUPANCY

.1 The Site is vacant land and Contractor shall have full access to site.

1.8 SAFETY AND SECURITY DURING CONSTRUCTION IN NEAR BUILDINGS

.1 Building Exits: All exits, including stairways and exterior doors to the outside, serving the building shall be maintained.

.2 Fire Department Access: Construction activities shall not obstruct the access roadways designated for fire department equipment.

.3 Combustible Materials: Stockpiling of construction materials in the existing building shall be carefully controlled. The Ontario Fire Code prohibits such storage where the materials create a fire hazard to the existing building or its occupants. The control of combustibles on a construction site is also regulated under the Occupational Health and Safety Act.

.4 Existing Fire Alarm Systems: Maintain the existing fire alarm system operating properly during construction.

.6 Fire Protection Systems: Conform to the appropriate requirements of the Ontario Fire Code where temporary shutdown of sprinkler system, standpipe system or other fire protection system is necessary due to alterations, repairs or extensions.

.7 Provide temporary portable fire extinguishers throughout the work and at every work area.

.8 Prior to execution of any work which may possibly start a fire, that proper and suitable precautions and fire extinguishers are provided by trades executing the work. Provide “fire-watch” during welding operations and for minimum 4 hours after work is complete.

1.8 PROJECT MEETINGS

.1 Attend project Bi-weekly meetings.

.2 Representatives of the Contractor, Subcontractor and suppliers attending meetings shall be qualified and authorized to act on behalf of party each represents.

.3 Consultant shall distribute written notice of meetings, prepare agenda, record minutes and distribute copies of minutes.

.4 Contractor to provide meeting location as per Section 01 52 00 Construction Facilities.

1.09 HEALTH & SAFETY

.1 The Owner is firmly committed to Corporate Health & Safety.

.2 The Contractor shall have Corporate Health and Safety Policies and Procedures as required in the Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1980.

.3 To provide a safe and healthy work environment the Contractor warrants and confirms:

.1 that it has a written Health and Safety policy in place in accordance with the Occupational Health and Safety Act, R.S.O. 1990;

.2 that the appropriate instruction and training has been provided to the employees in accordance with the Occupational Health and Safety Act, R.S.O. 1990 and

.3 that the works shall be undertaken in strict accordance with all applicable provisions of the Occupational Health and Safety Act.

Note: In cases of discrepancy in document content, the Policy or Procedure providing the highest level of Health and Safety shall govern.

.4 The contractors's documentation and commitment to Health & Safety will be a requirement of this contract.

.5 Submit copies of incident and accident reports.

1.10 FILING OF NOTICE

.1 File Notice of Project with Ontario Ministry of Labour prior to beginning of Work.

1.11 REGULATORY REQUIREMENTS

.1 References and Codes

.1 Perform Work in accordance with the Ontario Building Code (OBC) including amendments up to tender closing date and other codes of provincial or local

application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.12 INSPECTION

.1 Allow Owner and Consultant 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.

.2 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 at no cost to Owner.

.3 Consultant shall order 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.

1.13 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 at no cost to the Owner.

.2 Make good other Contractor's work damaged by such removals or replacements promptly at no cost to the Owner.

.3 If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner shall 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.

1.14 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

.2 Remove waste materials from site at daily regularly scheduled times. Do not burn waste materials on site.

.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use marked separate bins for recycling.

.6 Dispose of waste materials and debris off site.

.7 Protect existing materials and equipment from damage during construction. Provide polyethylene cover over any furniture and equipment remaining in work area in order to minimize damage from construction dirt and debris.

.8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

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

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants shall not fall on wet, newly painted surfaces nor contaminate building systems.

1.10 PROTECTION OF BUILDING

.1 Protect property in, or on, existing building including equipment, furniture and other similar furnishings, hardware, trim and supplies whether fixed to the building or not.

.2 Take all precautions to ensure that no structural damage is caused to existing building by demolition and alteration work, or by new construction.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

.1 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage installation and other authorized expenses incurred in performing Work.

.2 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.

.3 Contract Price, and not cash allowance, includes HST payable in connection with such cash allowance.

.4 Contract Price shall be adjusted by written order to provide for excess or deficit to each cash allowance.

.5 If overhead and profit to the Contract are determined by means not identified in the Contract Documents, edit the following paragraph to suit conditions accordingly.

.6 Where costs under a cash allowance exceed amount of allowance, Contractor shall 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 Authorization to Disburse Allowances: Expenditures from Allowances included in the contract must be authorized in writing by the Consultant, the Owner and the Contractor and issued as a Cash Allowance Disbursement Authorization (CADA).

.9 Include the following cash allowances in the **Cash Allowance section** of the bid form and shall not be included in the Lump Sum Value.

.1 Cash Allowance: **Forty Thousand Dollars ($40,000.00)** to cover the following items from which the Consultant shall direct payment for services, labour, and material.

.1 Provisional Cash Allowance

.2 Testing and Inspections

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Contract modification procedures.

1.2 VARIATIONS

.1 Once a Proposed Change has been issued by the Consultant, it shall be the responsibility of the Contractor to ensure that no work is carried out that may increase the cost of the variation contemplated until a decision on the acceptance or rejection of the Proposed Change is made, and a Change Order signed by the owner has been issued.

.2 The Owner and Consultant shall assess the cost of each change before issuing a Change Order.

1. Assist the Consultant with this task by quoting all variations in a complete manner listing:
    1. quantity of each material,
    2. unit cost of each material,
    3. man hours involved,
    4. cost per hour,
    5. Subcontractor quotations,
    6. impact on Project schedule and completion, and
    7. overhead and profit fees.

.3 The Consultant may require further quotations to show a breakdown of costs.

.4 The Owner and the Consultant shall not be responsible for delays to the Work resulting from late, incomplete or inadequately broken down valuations submitted by the Contractor.

.5 Minor variations may be made in the project from time to time as approved by the Owner and Consultant. Such alterations or adjustments shall not constitute a change in cost unless a Proposed Change is made at the time. No additional cost shall be contemplated except where a clear indication is made and approved by the owner in writing that additional costs were incurred, in this case a Change Order shall be issued by the Consultant. Unless this procedure is followed, no claims for additional amounts shall be allowed.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Owner/Contractor Agreement; CCDC2-2020

1.2 APPLICATIONS FOR PROGRESS PAYMENT

.1 Make applications for payment on account monthly as Work progresses.

.2 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.

.3 Submit to Consultant, at least 15 days before first application for payment. Schedule of values for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of applications for payment.

1.3 SCHEDULE OF VALUES

.1 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.

.2 Include statement based on schedule of values with each application for payment.

.3 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.

.4 Schedule of Values to include a value of **Thirty-Five Thousand Dollars ($35,000.00)** for project close-out documents (as-builts and maintenance manuals). Payments for close-out documents shall be released after documents are submitted and approved by the consultants.

1.4 SUBSTANTIAL PERFORMANCE OF WORK

.1 Apply for a review by Consultant to establish Substantial Performance of Work when Work is substantially performed if permitted by lien legislation applicable to Place of Work

.2 No later than 10 days after receipt of list and application, Consultant shall review Work to verify validity of application, and no later than 7 days after completing review, shall notify Contractor if Work or designated portion of Work is substantially performed.

.3 Consultant shall state date of Substantial Performance of Work in certificate.

.4 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Consultant, establish reasonable date for finishing Work.

1.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

.1 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.

.2 After receipt of application for payment and sworn statement, Consultant shall issue certificate for payment of holdback amount.

.3 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. Owner may retain out of holdback amount sums required by law to satisfy liens against Work.

1.6 FINAL PAYMENT

.1 Submit application for final payment when Work is completed.

.2 Consultant shall, no later than 10 days after receipt of application for final payment, review Work to verify validity of application. Consultant shall give notification that application is valid or give reasons why it is not valid, no later than 7 days after reviewing Work.

.3 Consultant shall issue final certificate for payment when application for final payment is found valid.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 ADMINISTRATIVE

.1 Security and control of Project is the responsibility of the Contractor.

.2 Contractor responsible as to which trade provides required materials or articles and work.

.3 Contractor responsible for the coordination of all building components, materials and systems and the work of al subcontractors. The Contractor shall provide field drawings to coordinate the various parts of the work prior to commencement of work.

1.2 RELATED MECHANICAL AND ELECTRICAL WORK

.1 Coordination of the installation of systems specified in Structural, Mechanical and Electrical divisions including the interrelating operation and functioning between components of a system and between systems, is the responsibility of those performing the Work of Structural, Mechanical and Electrical divisions with final coordination the responsibility of the Contractor.

.2 Conceal pipes, ducts, control systems and electrical distribution systems within wall, floor and ceiling construction except where indicated otherwise.

.3 Ensure that pipes, conduit, wires, vents, regulators, meters and similar Project service installations are located in inconspicuous locations. If not indicated on Drawings, verify location of service installations with Consultant before commencing installation. Provide field drawings to the Consultant prior to any installation.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Schedule delivery of products, and provide delivery access and unloading areas.

.2 Provide areas for storage of products and construction equipment to meet specified requirements, and to ensure a minimum of interference with progress of the Work and relocations.

.3 All material, equipment and fixtures to be delivered, stored and handled as per manufacturer's written instructions.

1.4 JOB CONDITIONS

.1 Ensure that conditions within the building are maintained. Ensure that protection of adjacent property and the Work is adequately provided for and maintained to meet specified requirements.

1.5 COORDINATION

.1 Review Contract Documents and advise the Consultant of possible conflicts between parts of the Work before preparation of shop drawings, ordering of products or commencement of affected Work.

.2 Coordinate all Work in each area and Work on which subsequent Work depends to facilitate mutual progress, and to prevent conflict between parts of the Work.

.3 Ensure that each Section, before commencing its Work, knows requirements for subsequent Work and that each Section is assisted in the execution of its preparatory Work by Sections whose Work depends upon it.

.4 Ensure that setting drawings, templates, and all other information necessary for the location and installation of materials, holes, sleeves, inserts, anchors, accessories, fastenings, connections, and access panels are provided by each Section whose Work requires cooperative location and installation by other Sections, and that such information is communicated to the applicable installer.

1.6 CUTTING AND PATCHING

.1 Before cutting, drilling, or sleeving structural load-bearing elements, obtain approval of location and methods.

.2 Cut and drill with true smooth edges and to minimum suitable tolerances.

.3 Fit construction tightly to ducts, pipes and conduits to stop air movement completely. The Section performing Work that penetrates a fire, air, vapour, moisture, thermal or acoustic separation of the building shall pack voids tightly with rock wool; seal air, vapour and moisture barriers; and caulk joints as may be required to ensure that no air movement through the penetration is possible. Where cutting and chasing reduces wall thickness, reinforce wall as required.

.4 Replace, and otherwise make good, damaged work at no cost to Owner.
Make patches invisible in final assembly within physical limitations of materials as approved by Consultant.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 ADMINISTRATIVE

.1 Schedule project meetings throughout the progress of the work, every other week.
.2 Provide physical space and make arrangements for meetings.
.3 Attend meetings.
.4 Representative of Contractor, Subcontractor and suppliers attending meetings shall be qualified and authorized to act on behalf of party each represents.
.5 Consultant shall distribute written notice of meetings, prepare agenda, record minutes and distribute copies of minutes.

1.2 PRECONSTRUCTION MEETING

.1 Within 15 days after award of Contract (Letter of Intent), request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
.2 Client Representatives, Consultant, Contractor, Major Subcontractors and site supervisor shall be in attendance.
.3 Establish time and location of meeting and notify parties concerned.
.4 Consultant to provide agenda.
.5 Contractor to have available prior to meeting, construction schedule, Schedule of Values and all contract security.

1.3 PROGRESS MEETINGS

.1 During course of Work schedule and attend progress meetings.
.2 Contractor, major Subcontractors involved in Work, Consultant and Owner are to be in attendance.
.3 Contractor to have available prior to meeting, construction schedule and schedule of Values.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 DEFINITIONS

.1 Activity: elements of Work performed during the course of Project. Activity has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Bar Chart shall be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, shall provide five-day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

1.2 REQUIREMENTS

.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, and Substantial Performance as defined times of completion are of essence of this contract.

1.3 ACTION AND INFORMATION SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit Project Schedule to Owner and Consultant within 5 working days of receipt of signed Contract.

1.4 PROJECT SCHEDULE

.1 Develop detail Project Schedule

.2 Ensure detail Project Schedule includes a minimum of milestone and activity types as follows:

- .1 Award
- .2 Shop Drawing Submission, Samples
- .3 Permits
- .4 Mobilizations
- .5 Demolition
- .6 Architectural
- .7 Plumbing
- .8 Lighting
- .9 Electrical
- .10 HVAC

.11 Finishes
.12 Millwork
.13 Landscape/Architectural Site
.14 Close-out Documentation Submission
.15 Substantial Performance

1.5 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.
.2 Updated Project Schedule must be included with each progress draw submission.
.3 Discuss Project Schedule at regular site meetings, identifying activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule
.4 Weather related delays with their remedial measures shall be discussed and negotiated.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 ADMINISTRATIVE

.1 Submit to Owner and Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default shall be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in Imperial units.

.4 Review submittals prior to submission to Owner and Consultant. This review represents that necessary requirements have been determined and verified, or shall be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project shall be returned without being examined and considered rejected.

.5 Notify Owner and Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.6 Verify field measurements and affected adjacent Work are co-ordinated.

.7 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.

.8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.

.9 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items shall be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 7 days for Consultant's review of each submission.

.5 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, achieve approval in writing from Owner and Consultant prior to proceeding with Work.

.6 Make changes in shop drawings as Owner and Consultant may require, consistent with Contract Documents. When resubmitting, notify Owner and Consultant in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.8 Submissions 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, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of 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 Relationship to adjacent work.

.9 After Consultant's review, distribute copies.

.10 Submit 1 electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.

.11 Submit 1 electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant where shop drawings shall not be prepared due to standardized manufacture of product.

.12 Submit 1 electronic copy of test reports for requirements requested in specification Sections and as requested by Consultant.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.13 Submit 1 electronic copy of certificates for requirements requested in specification Sections and as requested by Consultant.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit 1 electronic copy of manufacturer's instructions for requirements requested in specification Sections and as requested by Consultant.

.1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit 1 electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Consultant.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit 1 Hard copy and 1 digital copy (PDF Format) of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Consultant.

.18 Delete information not applicable to project.

.19 Supplement standard information to provide details applicable to project.

.20 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies shall be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy shall be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.3 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Consultant's business address.

.3 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Make changes in samples which Consultant may require, consistent with Contract Documents.

.6 Reviewed and accepted samples shall become standard of workmanship and material against which installed Work shall be verified.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 SECTION INCLUDES

.1 Health and safety considerations required to ensure that the Contractor shows due diligence towards health and safety on construction sites.

1.2 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).
  .2 Occupational Health and Safety Act, S.N.S. 1996.
.3 Province of Ontario
  .1 Occupational Health and Safety Act, R.S.O. 1990 Updated 2005.

1.3 HEALTH & SAFETY

.1 The Owner is firmly committed to Corporate Health & Safety.
.2 The Contractor shall have Corporate Health and Safety Policies and Procedures as required in the Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1980.
.3 To provide a safe and healthy work environment the Contractor warrants and confirms:
  .1 that it has a written Health and Safety policy in place in accordance with the Occupational Health and Safety Act, R.S.O. 1990;
  .2 that the appropriate instruction and training has been provided to the employees in accordance with the Occupational Health and Safety Act, R.S.O. 1990 and
  .3 that the works shall be undertaken in strict accordance with all applicable provisions of the Occupational Health and Safety Act.
  Note: In cases of discrepancy in document content, the Policy or Procedure providing the highest level of Health and Safety shall govern.
.4 Submit copies of incident and accident reports.

1.4 FILING OF NOTICE

.1 File Notice of Project with Ontario Ministry of Labour prior to beginning of Work.

1.5 REGULATORY REQUIREMENTS

.1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.6 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, territorial and local statutes, regulations, and ordinances.

1.7 COMPLIANCE REQUIREMENTS

.1 Comply with Ontario Health and Safety Act, R.S.O.
.2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.8 UNFORSEEN 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 of Ontario having jurisdiction and advise Owner and Consultant in writing.

1.9 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 of Ontario having jurisdiction.

1.10 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Owner and Consultant.

.2

1.11 BLASTING

.1 Blasting or other use of explosives is not permitted.

1.12 POWDER ACTUATED DEVICES

.1 Powder actuated devices are not permitted.

1.13 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.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 FIRES

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

1.2 DRAINAGE

.1 Provide temporary drainage and pumping required to keep excavations and site free from water.

.2 Control disposal or runoff of water in accordance with local authority requirements.

1.3 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties as indicated.

.2 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.

.3 Avoid unnecessary traffic, dumping and storage of materials over root zones.

1.4 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this Contract.

.2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.

.3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.5 NOTIFICATION

.1 Consultant shall notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 Contractor: after receipt of such notice, inform Consultant of proposed corrective action and take such action for approval by Consultant.

.1 Take action only after receipt of written approval by Consultant.

.3 Consultant shall issue stop order of work until satisfactory corrective action has been taken.

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products - Not Used

Part 3 Execution

3.1 CLEANING

.1 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

.2 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion of each section remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.4 Waste Management: separate waste materials for reuse or recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

End of Section

Part 1 General

1.1 REFERENCES AND CODES

.1 Perform Work in accordance with the Ontario Building Code (OBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 INSPECTION

.1 Allow Owner and Consultant access to Work.

.2 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 at no additional cost to the Owner.

.3 Give at least 48 hours' notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultants or law of Place of Work.

.4 Consultant shall order 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 at no additional cost to the Owner and pay cost of examination and correction.

1.2 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 at no additional cost to the Owner. Replace or re-execute in accordance with Contract Documents.

.2 If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner shall deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be reasonably determined by Consultant.

1.3 TESTING & REPORTS

.1 Submit electronic copies of inspection and testing reports to Owner and Consultant.

.2 Furnish test results and mix designs as requested.

1.4 MOCK-UPS

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.

.2 Prepare mock-ups for Owner and Consultants review with reasonable promptness and in orderly sequence, to not cause delays in Work.

.3 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract time and no claim for extension by reason of such default shall be considered.

.4 Mock-ups may remain as part of the work.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.2 DEWATERING

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

1.3 WATER SUPPLY

.1 Arrange, provide and pay for continuous supply of potable water for construction use.

1.4 TEMPORARY HEATING AND VENTILATION

.1 Provide temporary heat required during construction period, including attendance, maintenance and fuel.

.2 Construction heaters used inside building must be vented to the outside and be non-flameless type. Solid fuel salamanders are not permitted.

.3 Provide temporary heat and ventilation in enclosed areas as required to:

- .1 Facilitate progress of work.
- .2 Protect Work and products against dampness and cold.
- .3 Prevent moisture condensation on surfaces.
- .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health and safety regulations for safe working environment.

.4 Ventilating:

- .1 Dispose of exhaust materials in manner that shall not result in harmful exposure to persons.
- .2 Ventilate storage spaces containing hazardous or volatile materials.
- .3 Ventilate temporary sanitary facilities.
- .4 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.5 Permanent heating system of building is not to be used when available.

.6 Maintain strict supervision of operations of temporary heating and ventilation equipment to:

- .1 Conform with applicable codes and standards.
- .2 Enforce safe practices.
- .3 Prevent abuse of services.
- .4 Prevent damage to finishes.
- .5 Vent direct-fired combustion units to outside.

.7 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.5 TEMPORARY POWER AND LIGHT

.1 Arrange, provide and pay for temporary power during construction for operating of power tools, to a maximum supply of 230 volts 30 amps.

.2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.

.3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is sufficient for work commencing.

1.6 TEMPORARY COMMUNICATION FACILITIES

.1 Provide and pay for telephone, data and all necessary communication devices for own use.

1.7 FIRE PROTECTION

.1 Burning rubbish and construction waste materials is not permitted on site.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.2 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.
.3 CAN/CSA-Z321-96(R2006), Signs and Symbols for the Occupational Environment.

1.2 INSTALLATION AND REMOVAL

.1 Provide construction facilities in order to execute work expeditiously.
.2 Remove from site all such work after use.

1.3 SCAFFOLDING

.1 Scaffolding in accordance with CAN/CSA-S269.2.
.2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms.

1.4 SITE STORAGE/LOADING

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
.2 Do not load or permit to load any part of Work with weight or force that shall endanger Work.
.3 A small site storage / laydown areas shall be available, Locations to be approved by Owner.

1.5 CONSTRUCTION PARKING

.1 Parking shall be permitted on site in designated areas only. A limited number of parking spaces shall be provided on site.
.2 Provide and maintain adequate access to project site.

1.6 OFFICES

.1 Provide office with adequate heating, lighting, and ventalation of sufficient size to accommodate site meetings and furnished with drawing laydown table.
.2 Provide marked and fully stocked first-aid case in a readily available location.
.3 Subcontractors to provide their own offices as necessary.

1.7 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.8 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
.2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
.3 Existing and new public facilities shall not be available for construction staff. Dedicated sanitary facilities shall be provided and maintained by the General Contractor.

1.9 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed.
.2 Provide measures for protection and diversion of traffic, including provision of watch-persons 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 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

.5 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic. Provide as required by governing authorities.

1.10 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 daily.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.2 SITE FENCING | PROTECTION

.1 Erect temporary site enclosure using new 6'-0" (1.8 m) high portable construction fence. Provide minimum one lockable truck gate. Maintain fence in good repair.

.2 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 governing authorities.

1.4 WEATHER ENCLOSURES

.1 Provide weather tight enclosures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

1.5 ACCESS TO SITE

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

1.6 FIRE ROUTES

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

1.7 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 at no additional cost to Owner

1.8 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished areas of building and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Be responsible for damage incurred due to lack of or improper protection at no additional cost to Owner.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 REFERENCES

.1 Within text of each specifications section, reference may be made to reference standards.

.2 Conform to these reference standards, in whole or in part as specifically requested in specifications.

.3 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.

.4 Cost for such testing shall be borne by party requesting testin in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

.1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.

.3 Defective products, whenever identified prior to completion of Work, shall be rejected, regardless of previous inspections. Inspection does not relieve Contractor's responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.4 Should disputes arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.

.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work. Authorization must be approved in writing by Owner and Consultant before ordering.

.2 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.5 Remove and replace damaged products at own expense and to satisfaction of Owner and Consultant.

.6 Touch-up damaged factory finished surfaces to Owner's and Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

1.6 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify Owner and Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant shall establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Owner and Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Owner and Consultant in writing if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Owner and Consultant reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.

1.8 CO-ORDINATION

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 CONCEALMENT

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform Consultant if there is interference. Install as directed by Consultant.

1.10 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Consultant of conflicting installation. Install as directed.

1.12 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.14 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Consultant.

1.15 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Record location of capped service.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 SURVEY REFERENCE POINTS

.1 Existing base horizontal and vertical control points are designated on drawings.

.2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.

.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.

1.2 SURVEY REQUIREMENTS

.1 Establish permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.

.2 Establish lines and levels, locate and lay out, by instrumentation.

.3 Stake for grading, and fill placement.

.4 Establish pipe invert elevations.

.5 Stake batter boards.

.6 Establish foundations, column locations and floor elevations.

.7 Establish lines and levels for mechanical and electrical work.

1.3 EXISTING SERVICES

.1 Before commencing work, establish location and extent of service lines in area of Work.

.2 Remove abandoned service lines within 6 feet of structures. Cap or otherwise seal lines at cut-off points.

1.4 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.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 Submit field drawings to indicate relative position of various services and equipment.

1.5 RECORDS

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 Record locations of maintained, re-routed and abandoned service lines.

1.6 SUBSURFACE CONDITIONS

.1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Geotechnical Report
After prompt investigation, should Consultant determine that conditions do differ materially, instructions shall be issued in writing for changes in Work accordingly.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not used

End of Section

Part 1 General

1.1 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit written request in advance of cutting or alteration which affects:

.1 Structural integrity of elements of project.

.2 Integrity of weather-exposed or moisture-resistant elements.

.3 Efficiency, maintenance, or safety of operational elements.

.4 Visual qualities of sight-exposed elements.

.5 Work of Owner or separate contractor.

.3 Include in request:

.1 Identification of project.

.2 Location and description of affected Work.

.3 Statement on necessity for cutting or alteration.

.4 Description of proposed Work, and products to be used.

.5 Alternatives to cutting and patching.

.6 Effect on Work of Owner or separate contractor.

.7 Written permission of affected separate contractor.

.8 Date and time work shall be executed.

1.2 MATERIALS

.1 Required for original installation.

.2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 EXECUTION

.1 Execute cutting, fitting, and patching to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.6 Execute Work by methods to avoid damage to other Work, and which shall provide proper surfaces to receive patching and finishing.

.7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior written approval.

.9 Restore work with new products in accordance with requirements of Contract Documents.

.10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, full thickness of the construction element.

.12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

.2 Remove waste materials from site daily in an MOE-approved manner. Do not burn waste materials on site.

.3 Clear snow and ice from access to building, remove from site.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling.

.7 Dispose of waste materials and debris off site.

.8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

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

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants shall not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

.1 Refer to CCDC 2, GC 12.1

.2 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.3 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.4 Prior to final review remove surplus products, tools, construction machinery and equipment.

.5 Remove waste materials from site at regularly scheduled times. Do not burn waste materials on site.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, ceilings, floors.

.9 Clean lighting reflectors, lenses, and other lighting surfaces.

.10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.14 Remove dirt and other disfiguration from exterior surfaces.

.15 Clean and sweep roofs, gutters, areaways, and sunken wells.

.16 Sweep and wash clean paved areas.

.17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.18 Clean roofs, downspouts, and drainage systems.

.19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.20 Remove snow and ice from access to building.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse or recycling. A dedicated waste management and disposal program is mandatory.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 ADMINISTRATIVE PROCEDURES

.1 Acceptance of Work Procedures:
- .1 Contractor's Inspection: conduct inspection of Work , identify deficiencies and defects, and repair as required to conform to Contract documents.
- .2 Notify Owner and Consultant in writing of satisfactory completion of Contractors inspection and submit verification that corrections have been made.
- .3 Request Consultants inspections.
- .4 Owner, Consultants and Contactor to inspect Work and identify defects and deficiencies. Contractor to correct Work as directed in a timely manner.

.2 Completion Tasks: submit written certificates and tasks have been performed as follows:
- .1 Work completed and inspected in compliance with Contract Documents.
- .2 Defects / deficiencies have been corrected and completed
- .3 Equipment and systems: Tested and balanced and fully operational as per Mechanical and electrical specifications.
- .4 Commissioning and Operations of systems demonstrated to Owner's personnel.

1.2 CLOSEOUT PROCEDURES

.1 The Owner and Consultant shall not commence deficiency review until the General Contractor's own itemized deficiencies have been completed. The Consultant shall make **one inspection** for deficiencies review and one final review at competition of all items. Each additional Site review shall be made at a cost of **$1,200.00 per visit** to be paid by the General Contractor.

.2 Contractor to accompany Consultant on deficiency inspection.

.3 Contractor to correct items of work listed on deficiency list in a efficient manner to allow owner areas to be turn over to Owner in a timely manner.

.4 Notify in writing to Owner and Consultant when all corrective work is completed.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Two weeks prior to Substantial Performance of the Work, submit to the Owner and Consultant one **(1) hard copy** and **one (1) digital copy** of final operating and maintenance manuals in English, and hard copy of Record Drawings.

.2 Provide spare parts, extra stock materials maintenance materials and special tools of same quality and manufacture as products provided in Work.

1.4 FORMAT

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 1 'D' ring, loose leaf, to suit 8 ½’ x 11” size paper, with spine and face pockets to be left on site.

.3 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.4 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.5 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.6 Text: manufacturer's printed data, or typewritten data.

.7 Drawings: provide with reinforced punched binder tab, bind in with text; fold larger drawings to size of text pages.

1.5 CONTENTS - PROJECT RECORD DOCUMENTS

.1 Table of Contents for Each Volume: provide title of project;
- .1 Date of submission; names.
- .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
- .3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:
.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
.5 Typewritten Text: as required to supplement product data.
.1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
.6 As Built Drawings: digital copies shall be prepared by the Consultant.

1.6 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, at site one record copy of:
.1 Contract Drawings.
.2 Specifications.
.3 Addenda.
.4 Change Orders and other modifications to Contract.
.5 Reviewed shop drawings, product data, and samples.
.6 Field test records.
.7 Inspection certificates.
.8 Manufacturer's certificates.
.2 Store record documents and samples in field office apart from documents used for construction.
.3 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
.4 Keep record documents and samples available for inspection by Consultant.

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of opaque drawings.
.2 Use felt tip or ball point pens to record information, maintaining separate colours for each major system.
.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
.4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
.1 Field changes of dimension and detail.
.2 Changes made by change orders.
.3 Details not on original Contract Drawings.
.4 References to related shop drawings and modifications.
.5 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
.6 Provide digital photos, if requested, for site records.
.7 Prior to Substantial Performance deliver Record Documents to Consultant for preparation of digital As Built Drawings. Consultant shall transfer notations from opaque drawings to digital format.

1.8 MATERIALS AND FINISHES

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional requirements: as specified in individual specifications sections.

1.9 MAINTENANCE MATERIALS

.1 Spare Parts, Extra Stock Materials and Special Tools:

.1 Provide, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site; place and store.

.4 Receive and catalogue items.

.1 Include inventory listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

1.11 WARRANTIES AND BONDS

.1 Assemble warranty and bond 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.

.2 Leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.3 Respond in timely manner to oral or written notification of required construction warranty repair work.

PART 2 – PRODUCTS – Not Used
PART 3 – EXECUTION – Not used

End Of Section

Part 1 General

1.1 ADMINSTARTIVE REQUIREMENTS

.1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel one week prior to date of substantial performance.

.2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

.3 Preparation:

.1 Verify conditions for demonstration and instructions comply with requirements.

.2 Verify designated personnel are present.

.3 Ensure equipment has been inspected and put into operation in accordance with Mechanical and electrical Specifications

.4 Ensure testing, adjusting, and balancing has been performed [in accordance with Mechanical and electrical Specifications and equipment and systems are fully operational.

.4 Demonstration and Instructions:

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.

.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 Time Allocated for Instructions: allow adequate time required for instruction of each item of equipment.

1.2 QUALITY CONTROL

.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

.1 Instruct Owner's personnel of time and location.

.2 Provide written report that demonstration and instructions have been completed.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not used

End of Section

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA S350-(R2003), Code of Practice for Safety in Demolition of Structures.

1.2 SITE CONDITIONS

.1 Take precautions to protect the environment.

.2 Should material resembling spray or trowel-applied asbestos or other designated substance be encountered, stop work, take preventative measures, and notify Owner and Consultant immediately.

.1 Do not proceed until written instructions have been received from Owner and Consultant.

.3 Notify Owner and Consultant in writing, minimum 6 days before disrupting building access or services.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 EXAMINATION

.1 Inspect site with Consultant and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Consultant and utility company concerned in case of damage to any utility or service, designated to remain in place.

.2 Immediately notify the Consultant should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways,

.2 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work..

.2 Protection of In-Place Conditions:

.1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features to remain in place. Provide bracing and shoring required.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do Work in accordance with Section 01 35 29 - Health & Safety Requirements.

.3 Demolition/Removal:

.1 Remove items as indicated.

.2 Removal of Pavements, Curbs and Gutters:

.1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Consultant.
.2 Protect adjacent joints and load transfer devices.
.3 Protect underlying and adjacent granular materials designated to remain.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.
.2 Final Cleaning: upon substantial completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
.3 Refer to demolition drawings and specifications for items to be salvaged for reuse.
.4 Waste Management: separate waste materials for reuse or recycling.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 DEMOLITION AND DISPOSAL

.1 Remove parts of the building to permit new work.
.2 Dispose of removed material, except where specified otherwise, in accordance with authority having jurisdiction.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Concrete Reinforcing: Section 03 20 00

.2 Cast-In-Place: Concrete Section 03 30 00

.3 Joint Sealants: Section 07 90 00

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CSA A23.1-14 /A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA O86-14, Engineering Design in Wood.

.3 CSA O121-08 (R2013), Douglas Fir Plywood.

.4 CSA O151-09 (2014), Canadian Softwood Plywood.

.5 CSA O153-13, Poplar Plywood.

.6 CAN/CSA O325.0-16, Construction Sheathing.

.7 CSA O437 Series-93 (R2011), Standards for OSB and Waferboard.

.8 CSA S269.1-16, Falsework and Formwork.

.9 CAN/CSA S269.3-M92 (R2003), Concrete Formwork.

.2 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, and handle materials in accordance with Section 01 61 00 Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from damages.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121.

.2 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.

.3 Rigid insulation board: to CAN/ULC-S701.

.2 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes minimum 25 mm diameter in concrete surface.

.3 Form release agent: proprietary, non-volatile material not to stain concrete or impair subsequent application of finishes or coatings to surface of concrete, derived from agricultural sources, non-petroleum containing, non-toxic, low VOC.

.4 Falsework materials: to CSA S269.1.

.5 Sealant: to Section 07 90 00 Joint Sealants.

Part 3 Execution

3.1 FABRICATION AND ERECTION

.1 Refer to architectural drawings for concrete members requiring architectural exposed finishes.

.2 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.3 Fabricate and erect formwork in accordance with CAN/CSA S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.

.4 Use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners, joints, unless specified otherwise.

.5 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.6 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.7 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 2 days for footings foundation walls.

.2 Remove formwork when concrete has reached 70% of its 28-day design strength or minimum period noted above, whichever comes later.

.3 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 Cleaning.

.1 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.

End of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Concrete Forming and Accessories: Section 03 10 00

.2 Cast-In-Place Concrete: Section 03 30 00

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A1064/A1064M-17, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.2 CSA Group (CSA)

.1 CSA A23.1-14 /A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA A23.3-14, Design of Concrete Structures.

.3 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement.

.4 CSA G40.20/G40.21-13 (R2014), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CSA W186-M1990 (R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 Submittal Procedures.

.2 Shop Drawings:

.1 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Indicate placing of reinforcement and:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Consultant, with identifying code marks to permit correct placement without reference to structural drawings.

.3 Detail lap lengths and bar development lengths to CAN/CSA A23.3.

.4 Indicate position and size of openings in slabs and walls. Coordinate with trades requiring openings.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with 01 61 00 Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new at no additional cost to Owner.

Part 2 Products

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Consultant.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA G30.18, unless indicated otherwise.

.3 Cold-drawn annealed steel wire ties: to ASTM A1064/A1064M.

.4 Welded steel wire fabric: Plain in accordance ASTM A1064/A1064M, fabricated from as drawn steel wire into flat sheets; sizes as indicated on Drawings. Provide in flat sheets only.

.5 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.

.6 Tie wire: 1.5 mm diameter annealed wire.

.7 Mechanical splices: subject to approval of Consultant.

.8 Plain round bars: to CSA G40.20/G40.21.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Obtain Consultant's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.

Part 3 Execution

3.1 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.

.2 When field bending authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars - which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.

.2 Place reinforcing steel as indicated on placing drawings.

.3 Use plain round bars as slip dowels in concrete.

.1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.2 Apply thick even film of mineral lubricating grease when paint is dry.

.4 Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.

.5 Maintain cover to reinforcement during concrete pour.

3.3 FIELD QUALITY CONTROL

.1 Inspection of reinforcing and reinforcing materials carried out by Consultant to CSA A23.1/A23.2.

.2 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion of this section remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 Cleaning.

End of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Concrete Forming and Accessories: Section 03 10 00

.2 Concrete Reinforcement: Section 03 20 00

.3 Structural Steel for Buildings: Section 05 12 23

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM C260/C260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C494/C494M-16, Standard Specification for Chemical Admixtures for Concrete.

.4 ASTM C 881/C881M-15, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

.5 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.6 ASTM C C1059/C1059M-13, Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.

.7 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

.8 ASTM D624-2012, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

.9 ASTM D1751-04 (2013) e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.10 ASTM D1752-04a (2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 CSA Group (CSA)

.1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283-06-R2016, Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005),

1.3 ABBREVIATIONS AND ACRONYMS

.1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement types:

.1 GU, GUb and GUL - General use cement.

.2 MS and MSb - Moderate sulphate-resistant cement.

.3 MH, MHb and MHL - Moderate heat of hydration cement.

.4 HE, HEb and HEL - High early-strength cement.

.5 LH, LHb and LHL - Low heat of hydration cement.

.6 HS and HSb - High sulphate-resistant cement.

.2 Fly ash types:

.1 F - with CaO content maximum 8%.

.2 CI - with CaO content 15 to 20%.

.3 CH - with CaO minimum 20%.

.3 GGBFS - Ground, granulated blast-furnace slag.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings: In accordance with Section 01 31 19 Project Meetings, convene pre-installation meeting one week before beginning slab on grade placement.

.1 Ensure key personnel, site supervisor, Consultant, speciality Subcontractor - finishing, forming, concrete producer, testing laboratories attend.

.1 Verify project requirements.

.2 Discuss concrete placement sequence, locations of construction joints, protection of vapour barrier during concrete placement, continuity of vapour barrier, curing retarders, testing and finishing.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, product literature and data sheets for proprietary materials used in cast-in-place concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS Safety Data Sheet (SDS).

.3 Site Quality Control Submittals:

.1 Concrete pours: Submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in 3.4 FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Provide Consultant, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture meet specified requirements.

.3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Consultant on following items:

.1 Falsework erection.

.2 Cold weather concrete.

.3 Curing.

.4 Finishes.

.5 Formwork removal.

.4 Quality Control Plan: provide written report to Owner and Consultant verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver concrete to site of Work and discharged within 120 minutes maximum after batching.

.2 Modifying maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2. is prohibited.

.3 Deviations submitted for review by Consultant.

.4 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.8 SITE CONDITIONS

.1 Placing concrete during rain or weather events that could damage concrete is prohibited.

.2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/A23.2.

.3 Cold weather protection:

.1 Maintain protection equipment, in readiness on Site.

.2 Use such equipment when ambient temperature below 5°C, or when temperature may fall below 5°C before concrete cured.

.3 Placing concrete upon or against surface at temperature below 5°C is prohibited.

.4 Hot weather protection:

.1 Protect concrete from direct sunlight when ambient temperature above 27°C.

.2 Prevent forms of getting too hot before concrete placed. Apply accepted methods of cooling not to affect concrete adversely.

.5 Protect from drying.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in 2.4 - MIXES.

2.2 PERFORMANCE CRITERIA

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Consultant and provide verification of compliance as described in 1.6 - QUALITY ASSURANCE.

2.3 MATERIALS

.1 Portland Cement: GU.

.2 Blended hydraulic cement: Type GUb to CSA A3001.

.3 Portland-limestone cement: Type GUL to CSA A3001.

.4 Water: to CSA A23.1.

.5 Aggregates: to CSA A23.1/A23.2.

.6 Admixtures:

.1 Air entraining admixture: to ASTM C260.

.2 Chemical admixture: Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.

.7 Non premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 25 MPa at 28 days.

.8 Curing compound: to CSA A23.1/A23.2.

.9 Polyethylene film: To meet the requirements of CAN/CGSB-51.34. Slip Sheet to be 6 mil thickness and Under slab to be 10 mil thickness.

2.4 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet Consultant performance criteria to CSA A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.

.2 Provide concrete mixes to meet following hard state requirements:

.1 Interior Slab on Grade:

.1 Durability and class of exposure: N.

.2 Compressive strength at 28 days: 30 MPa minimum.

.3 Aggregate size: 20 mm maximum.

.4 Slump: 75mm ± 25mm

.2 Foundation Walls, Piers:

.1 Durability and class of exposure: F-2.

.2 Compressive strength at 28 days: 25 MPa minimum.

.3 Aggregate size: 20 mm maximum.

.4 Slump: 75mm ± 25mm

.5 Other Requirements:

.1 Air Entrainment: 6% ± 1%

.3 Exterior Aprons:

.1 OPSD 310.020

Part 3 Execution

3.1 PREPARATION

.1 Obtain Consultant's approval before placing concrete.

.1 Provide 24 hours minimum notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 Concrete Reinforcing.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitate placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete permitted only after approval of equipment and mix.

.5 Disturbing reinforcement and inserts during concrete placement is prohibited.

.6 Prior to placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.7 Protect previous Work from staining.

.8 Clean and remove stains prior to application for concrete finishes.

.9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, workability, air content, temperature and test samples taken.

.10 In locations where new concrete dowelled to existing work, drill holes in existing concrete.

.1 Place steel dowels and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.

.11 Do not place load upon new concrete until authorized by Consultant.

3.2 INSTALLATION/APPLICATION

.1 Do cast-in-place concrete work to CSA A23.1/A23.2.

.2 Sleeves and inserts:

.1 Do not permit penetrations, sleeves, ducts, pipes, or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Consultant.

.2 Where approved by Consultant, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.

.3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Consultant before placing of concrete.

.4 Confirm locations and sizes of sleeves and openings shown on drawings.

.5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.3 Anchor bolts:

.1 Set anchor bolts to templates in coordination with Section 05 12 23 Structural Steel in Buildings.

.4 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

.5 Finishing and curing:

.1 Finish concrete to CSA A23.1/A23.2.

.2 Use procedures noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration of compatibility of compounds used.

.4 Provide trowel finish unless otherwise indicated.

.5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.

.6 Joint fillers:

.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Consultant.

.2 When more than one piece required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.3 Locate and form construction and isolation joints as indicated.

.4 Install joint filler.

.5 Use ½" thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within ½" of finished slab surface unless indicated otherwise.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance to CSA A23.1 Straightedge Method.

3.4 FIELD QUALITY CONTROL

.1 Site tests: conduct tests as follows and in accordance with Section 01 45 00 Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.1 Concrete pours.

.2 Slump.

.3 Air content.

.4 Compressive strength at 7 and 28 days.

.5 Air and concrete temperature.

.2 Inspection and testing of concrete and concrete materials carried out by testing laboratory retained by the Contractor to CSA A23.1/A23.2.

.1 Ensure testing laboratory certified to CSA A283.

.3 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 Cleaning.

End of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Masonry Mortar & Grout: Section 04 05 12
.2 Masonry Anchorage & Reinforcing: Section 04 05 19
.3 Masonry Accessories: Section 04 05 23
.4 Unit Masonry: Section 04 20 00

1.2 REFERENCES

.1 CSA Group
  .1 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
  .2 CAN/CSA-A179-04(R2009), Mortar and Grout for Unit Masonry.
  .3 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meetings prior to commencing on site installations to:
  .1 Verify project requirements, including mock-up requirements.
  .2 Verify substrate conditions.
  .3 Co-ordinate products, installation methods and techniques.
  .4 Sequence work of related sections.
  .5 Co-ordinate with other building subtrades.
  .6 Review manufacturer's installation instructions.
  .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
  .8 Review warranty requirements.
.2 Include requirements for co-ordinating work that requires unusual scheduling with work in another Section.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry and include product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29 - Health & Safety Requirements.
.3 Samples:
  .1 Provide samples as follows:
    .1 2 of each type of concrete or stone masonry unit specified, including special shapes, supplemented with specific requirements in Sections.
    .2 2 coloured samples of mortar, illustrating mortar colour and colour range, supplemented with specific requirements in Section 04 05 12 - Masonry Mortar & Grout.
    .3 2 of each type of masonry anchorage, reinforcement and connector proposed for use, supplemented by specific requirements in Section 04 05 19 - Masonry Anchorage & Reinforcing.
.4 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements.
.5 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.

.6 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:
  .1 Verification of compliance of work with Contract.
  .2 Site visit reports providing detailed review of installation of work, and installed work.

1.5 CLOSEOUT SUBMITTALS

.1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Procedures & Submittals.

1.6 EXTRA MATERIALS

.1 Submit manufacturer's instructions in accordance with Section 01 78 00 - Closeout Procedures & Submittals covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.7 QUALITY ASSURANCE

.1 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.

.2 Construct mock-up panel of exterior and interior masonry wall construction minimum 4'-0" x 6'-0" (1200 x 1800 mm) showing masonry colours and textures, use of reinforcement, ties, jointing, pointing, coursing, mortar and quality of work.

.3 Mock-up used:

.1 To judge quality of work, substrate preparation, operation of equipment and material application.

.4 Construct mock-up where directed by Consultant.

.5 Allow 24 hours for inspection of mock-up by Consultant before proceeding with work.

.6 When accepted by Consultant, mock-up shall demonstrate minimum standard for this work. Mock-up may remain as part of finished work.

.7 Start work only upon receipt of written acceptance of mock-up by Consultant.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect material from nicks, scratches, and blemishes.

.3 Keep materials dry until use.

.4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

.5 Replace defective or damaged materials with new at no additional cost to Owner.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials.

1.9 SITE CONDITIONS

.1 Ambient Conditions: assemble and erect components when temperatures are above 4 degrees C.

.2 Weather Requirements: to CAN/CSA-A371.

.3 Cold weather requirements:

.1 To CAN/CSA-A371 with following requirements.

.1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.

.2 Maintain ambient temperature of masonry work and its constituent materials between 5 degrees C and 50 degrees C and protect site from wind chill.

.3 Maintain temperature of masonry above 0 degrees C for minimum of 7 days, after mortar is installed.

.4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.

.2 Hot weather requirements:

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

.2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

.3 Spray mortar surface at intervals and keep moist for maximum of 3 days after installation.

1.10 WARRANTY

.1 For Work in this Section 04 05 00 - Common Work Results for Masonry, 12 months warranty period is extended to 24 months.

Part 2 Products

2.1 MATERIALS

.1 Masonry materials are specified elsewhere in related Sections:

.1 Masonry Mortar & Grout: Section 04 05 12

.2 Masonry Anchorage & Reinforcing: Section 04 05 19

.3 Masonry Accessories: Section 04 05 23

.4 Unit Masonry: Section 04 20 00

Part 3 Execution

3.1 INSTALLERS

.1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

3.2 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section.

.2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.

.1 Inform Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

.3 Verification of Conditions:

.1 Verify that:

.1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete block.

.2 Field conditions are acceptable and are ready to receive work.

.3 Built-in items are in proper location, and ready for roughing into masonry work.

.2 Commencing installation means acceptance of substrates.

3.3 PREPARATION

.1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.

.2 Establish and protect lines, levels, and coursing.

.3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

.1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA-A371.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

.1 Exposed masonry:

.1 Remove chipped, cracked, and otherwise damaged units, in accordance with CAN/CSA-A165, in exposed masonry and replace with undamaged units.

.2 Jointing:

.1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.

.2 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.

.3 Cutting:

.1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

.4 Building-In:

.1 Build in items required to be built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

.5 Wetting of bricks:

.1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1 g/minute/1000 mm^2: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.

.2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

.6 Support of loads:

.1 Use 25 MPa Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.

.2 Use grout to CAN/CSA-A179 where grout is used in lieu of solid units.

.3 Install building paper below voids to be filled with concrete or grout; keep paper 25 mm back from faces of units.

.7 Provision for movement:

.1 Leave 1/8" (3 mm) space below shelf angles.

.2 Leave ¼" (6 mm) space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.

.3 Built masonry to tie in with stabilizers, with provision for vertical movement.

.8 Loose steel lintels:

.1 Install loose steel lintels. Center over opening width.

.9 Control joints:

.1 Construct continuous control joints as indicated.

.10 Movement joints:

.1 Build-in continuous movement joints as indicated.

3.6 SITE TOLERANCES

.1 Tolerances in notes to CAN/CSA-A371 apply.

3.7 FIELD QUALITY CONTROL

.1 Site Tests, Inspection:
- .1 Perform field inspection and testing, payment to be made from allowance specified in Section 01 21 00
- .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

.2 Manufacturer's Services:
- .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, and protection 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 Schedule site visits to review work at stages listed:
  - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
  - .2 During progress of work.
  - .3 Upon completion of work, after cleaning is carried out.
- .4 Obtain reports within 3 days of review and submit immediately to Owner and Consultant.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.

.2 Waste Management: separate waste materials for reuse or recycling.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

.1 Temporary Bracing:
- .1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
- .2 Bracing approved by Consultant.
- .3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.

.2 Moisture Protection:
- .1 Keep masonry dry using waterproof, non staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.
- .2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
- .3 Air Temperature Protection: protect completed masonry as recommended in 1.9, SITE CONDITIONS.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Common Work Results for Masonry: Section 04 05 00
.2 Masonry Anchorage & Reinforcing: Section 04 05 19
.3 Masonry Accessories: Section 04 05 23
.4 Unit Masonry: Section 04 20 00

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
  .1 CAN/CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  .2 CAN/CSA A179-04(R2014), Mortar and Grout for Unit Masonry.
  .3 CAN/CSA A371-04(R2014), Masonry Construction for Buildings.
  .4 CAN/CSA-A3000-08., Cementitious Materials Compendium; CAN/CSA-A3002-03, Masonry and Mortar Cement.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
  .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
  .2 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.
.2 Samples:
  .1 Samples: provide unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:
    .1 Provide two samples of mortar for colour selections.
.3 Manufacturer's Instructions:
  .1 Provide manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: certified test reports [including sand gradation tests in accordance with CAN/CSA A179 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 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle Masonry Mortar & Grout materials in accordance with Section 01 61 00 - Common Product Requirements, supplemented as follows:
  .1 Deliver prepackaged, dry-blended mortar mix to project site in labelled plastic-lined bags each bearing name and address of manufacturer, production codes or batch numbers, and colour or formula numbers.
  .2 Maintain mortar, grout and packaged materials clean, dry, and protected against dampness, freezing, traffic and contamination by foreign materials.
.2 Packaging Waste Management: remove for reuse and recycling.

1.6 SITE CONDITIONS

.1 Ambient Conditions: maintain materials and surrounding air temperature to:
  .1 Minimum 10 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 Weather Requirements: CAN/CSA A371.

Part 2 Products

2.1 MATERIALS

.1 Use same brands of materials and source of aggregate for entire project.

.2 Cement:

- .1 Portland Cement: to CAN/CSA-A3000.
- .2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA A179.
- .3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA A179.
- .4 Packaged Dry Combined Materials for mortar: to CAN/CSA A179, using gray color cement.

.3 Aggregate: supplied by one supplier.

- .1 Fine Aggregate: to CAN/CSA A179, natural sand.
- .2 Course Aggregate: to CAN/CSA A179.

.4 Water: clean and potable.

2.2 COLOR ADDITIVES

.1 Use coloring admixture not exceeding 10% of cement content by mass, or integrally colored masonry cement, to produce colored mortar to match approved sample. Admixtures to be approved prior to use. Use in accordance with the specific manufacturer's recommendations. Mortar color sample as selected from manufacturer's standard color range.

2.3 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 Pointing Mortar: CAN/CSA A179, Type N using property specification with maximum 2 percent ammonium stearate or calcium stearate per cement weight.

.4 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: Type M based on proportion specifications.

.5 Following applies regardless of mortar types and uses specified above:

- .1 Mortar for stone: Type N based on proportion specifications.

.6 Mortar for grouted reinforced masonry: Type S based on proportion specifications.

2.4 MORTAR MIXING

.1 Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.

.2 Use a batch type mixer in accordance with CAN/CSA A179.

.3 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that shall retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

.4 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.

.5 Use mortar within 2 hours after mixing at temperatures of 32 degrees C or 2 ½ hours at temperatures under 10 degrees C.

2.5 GROUT MIXES

.1 Bond Beams: minimum grout mix 10 to 12.5 MPa strength at 28 days or as otherwise indicated on drawings; 200-250 mm slump; mixed in accordance with CAN/CSA A179.

.2 Lintels: minimum grout mix 10 to 12.5 MPa strength at 28 days or as otherwise indicated on drawings; 200-250 mm slump; mixed in accordance with CAN/CSA A179.

.3 Grout: minimum compressive strength of 12.5 MPa at 28 days or as otherwise indicated on drawings. Maximum aggregate size and grout slump: CAN/CSA A179.

2.6 GROUT MIXING

.1 Mix batched and delivered grout in accordance with CAN/CSA-A23.1 transit mixed.
.2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA A179.
.3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
.4 Do not use calcium chloride or chloride based admixtures.

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 CONSTRUCTION

.1 Do Masonry Mortar Grout work in accordance with CSA A179, except where specified otherwise.
.2 Apply parging in uniform coating of thickness indicated.

3.3 MIXING

.1 All pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes. Mixing by hand must be pre-approved by the Consultant.
.2 Clean all mixing boards and mechanical mixing machine between batches.
.3 Mortar must be weaker than the units it is binding.
.4 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.4 MORTAR PLACEMENT

.1 Install mortar to manufacturer's instructions.
.2 Install mortar to requirements of CAN/CSA A179.
.3 Remove excess mortar from grout spaces.

3.5 GROUT PLACEMENT

.1 Install grout in accordance with manufacturer's instructions.
.2 Install grout in accordance with CAN/CSA A179.
.3 Work grout into masonry cores and cavities to eliminate voids.
.4 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.
.5 Do not displace reinforcement while placing grout.

3.6 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
.2 Remove droppings and splashings using clean sponge and water.
.3 Clean masonry with low pressure clean water and soft natural bristle brush.
.4 Waste Management: separate waste materials for reuse and recycling.

3.7 PROTECTION OF COMPLETED WORK

.1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Common Work Results for Masonry: Section 04 05 00
.2 Masonry Mortar and Grout: Section 04 05 12
.3 Masonry Accessories: Section 04 05 23
.4 Unit Masonry: Section 04 20 00

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)
  .1 CAN/CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  .2 CAN/CSA A370-09, Connectors for Masonry.
  .3 CAN/CSA A371-04(R2014), Masonry Construction for Buildings.
  .4 CAN/CSA G30.18-M92(R2007), Billet-Steel Bars for Concrete Reinforcement.
  .5 CSA-S304.1-04(R2010), Design of Masonry Structures.
  .6 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Provide manufacturer's printed product literature, specifications and datasheets illustrating products to be incorporated into project for specified products.
.3 Shop Drawings:
  .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  .2 Provide shop drawings detailing bar bending details, anchorage details, lists and placing drawings
  .3 On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
.4 Samples:
  .1 Submit 2 samples of all masonry reinforcing units.
.5 Manufacturers' Instructions: submit manufacturer's installation instructions.

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.
.3 Mock-ups: Construct mock-ups in accordance with Section 01 45 00 Quality Control and requirements of 04 05 00 Common Work Results for Masonry.

1.5 FIELD MEASUREMENTS

.1 Make field measurements necessary to ensure proper fit of members.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance 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.
.3 Storage and Handling Requirements:
  .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect anchorage and reinforcing materials from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.

.4 Packaging Waste Management:
.1 Separate and recycle waste materials.

Part 2 Products

2.1 MATERIALS

.1 Bar reinforcement Steel: to CAN/CSA A371 and CAN/CSA G30.18, Grade W.
.2 Connectors: to CAN/CSA A370 and CSA-S304.1.
.3 Corrosion protection: to CSA-S304.1, galvanized to CSA-S304.1 and CAN/CSA A370.
.4 Fasteners: installed post-construction:
.1 Screw Shields and Plugs: plastic, install in mortar joints.
.2 Bolts and Screws: size and type to suit application, locate where indicated.
.3 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.
.4 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.
.5 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.
.5 Ties: hot dip galvanized to CAN/CSA A370 Table 5.2 Adjustable Unit Ties: to CAN/CSA-A370: proprietary type ties, type, style and size to suit application in accordance with manufacturer's recommendations.
.1 Acceptable Products:
.1 Concrete Block: Fero Block Shear Connector or approved alternate.
.2 Joint Reinforcement Ties: to CAN/CSA-A370:
.1 Single Wythe Joint Reinforcement: ladder or truss type:
.1 Steel wire, hot dip galvanized: to ASTM A641, Class 3 after fabrication.
.2 Multiple Wythe Joint Reinforcement: ladder or truss type: without moisture drip; non-adjustable:
.1 Steel wire, hot dip galvanized: to ASTM A641 Class 3 after fabrication.
.6 Anchors: to CAN/CSA A370:
.1 Anchor Bolts: conventional (unpatented) anchors, steel, galvanized to CAN/CSA A370 Table 5.2 finish.
.7 Conventional Bolts:
.1 Bolts: to ASTM A36, bar stock shop threaded, straight bolts with square or hex-headed nuts or bent bar anchors, shaped to suit installation.
.2 Plate anchors: steel to ASTM A36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.
.3 Through bolt rods: to ASTM A307 threaded rod or threaded ASTM A36 bar stock.

2.2 FABRICATION

.1 Fabricate reinforcing in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
.2 Fabricate connectors in accordance with CAN/CSA A370.
.3 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.
.4 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
.5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, Consultant with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, prior to commencing reinforcement work.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for anchorage and reinforcing materials installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Consultant.
- .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 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 PREPARATION

.1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.4 INSTALLATION

.1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA A370, CAN/CSA A371, CAN/CSA-A23.1 and CSA-S304.1 unless indicated otherwise.

.2 Prior to placing mortar or grout, obtain Consultant's approval of placement of reinforcement and connectors.

.3 Supply and install additional reinforcement to masonry as indicated.

3.5 BONDING AND TYING

.1 Bond walls of two or more wythes using metal connectors in accordance with CSA-S304.1, CAN/CSA A371 and as indicated.

.2 Tie masonry veneer to backing in accordance with OBC, CSA-S304.1, CAN/CSA A371 and as indicated.

.3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA A370, CAN/CSA A371 and manufacturer's instructions.
- .1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA A371 and as indicated.
- .2 Install horizontal joint reinforcement 400 mm on centre.
- .3 Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
- .4 Place joint reinforcement continuous in first joint below top of walls.
- .5 Lap joint reinforcement ends minimum 150 mm.
- .6 Connect joint corners and intersections with strap anchors 400 mm on centre.

3.6 REINFORCED LINTELS AND BOND BEAMS

.1 Reinforce masonry beams, masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.

.3 Support and position reinforcing bars in accordance with CAN/CSA-A371.

3.7 GROUTING

.1 Grout masonry in accordance with CSA-S304.1, CAN/CSA A371 and CAN/CSA A179 and as indicated.

3.8 ANCHORS

.1 Supply and install metal anchors as indicated.

3.9 LATERAL SUPPORT AND ANCHORAGE

.1 Supply and install lateral support and anchorage in accordance with CSA-S304.1 and as indicated.

3.10 MOVEMENT JOINTS

.1 Reinforcement shall not be continuous across movement joints unless otherwise indicated.

3.11 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 which develop cracks or splits.

3.12 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.13 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Common Work Results for Masonry: Section 04 05 00
.2 Masonry Mortar & Grout: Section 04 05 12
.3 Masonry Anchorage & Reinforcing: Section 04 05 19
.4 Unit Masonry: Section 04 20 00

1.2 REFERENCES

.1 ASTM International Inc.
  .1 ASTM D2240-05(2010), Standard Test Method for Rubber Property - Durometer Hardness.
.2 Canadian Standards Association (CSA International)
  .1 CAN/CSA A371-04(R2014), Masonry Construction for Buildings.
  .2 CAN/CSA-ISO 14021-00(R2009), Environmental Labels and Declarations - Self Declared Environmental Claims (Type II Environmental Labelling).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.
.3 Quality Assurance Submittals:
  .1 Manufacturer's Instructions: submit in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:
    .1 Submit installation instructions for masonry accessories used in project including fillers, reglets, brick vents, weeps, vents, screens and flashings

1.4 FIELD MEASUREMENTS

.1 Make field measurements necessary to ensure proper fit of members.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle masonry accessories in accordance with, Section 01 61 00 - Common Product Requirements supplemented as follows:
  .1 Keep fillers and adhesives dry, protected against dampness, and freezing.
  .2 Store packaged materials off ground and in accordance with manufacturer's written instructions.
.2 Packaging Waste Management: Separate waste materials for reuse and recycling.

Part 2 Products

2.1 MATERIALS

.1 Movement joint filler: purpose-made elastomer, 70 durometer hardness to ASTM D2240 of size and shape indicated with applied exterior sealant. Material to be expanded polyethylene in accordance with Section 07 90 00 Joint Sealing.
.2 Lap adhesive: recommended by masonry flashing manufacturer.
.3 Plastic or Rubber Membrane Masonry Flashing: flexible, self adhering, minimum 40 mil thickness, Bakor Blueskin, W.R. Meadows Mel-Rol, Grace Perm-A-Barrier or approved alternate.
.4 Sheet Metal Masonry Flashing: galvanized steel, min. 24 ga.
.5 Weep Hole Vents: PVC.
.6 Mortar diverters: shaped and sized to suit cavity spaces.
  .1 Cavity space size: 1” (25 mm).
.7 Grout Screens: ¼” (6 mm) square monofilament screen is fabricated form high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas. Size to suit installation

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for masonry accessories installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Consultant.
- .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: MATERIALS

.1 Install continuous movement joint fillers in movement joints at locations indicated on drawings.

.2 Lap adhesive: apply adhesive to flashing lap joints.

3.3 INSTALLATION: MOISTURE CONTROL

.1 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 24” (600 mm) on center.

.2 Mortar diverters: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

.3 Grout screens: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

3.4 INSTALLATION: FLASHINGS

.1 Build in flashings in masonry in accordance with CAN/CSA-A371.
- .1 Install metal and flexible membrane 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 metal and flexible membrane flashings from front edge of exterior masonry, under outer wythe, then up backing not less than 6” (150 mm), and as follows:
  - .1 For masonry backing embed or bond flashing 1” (25 mm) in joint.
  - .2 For wood frame backing, staple flashing to walls behind water resistive paper, and lap joints.
  - .3 For gypsum board and glass fibre faced sheathing backing, bond to wall using manufacturer's recommended adhesive.
- .3 Lap joints 6” (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 door jambs, to prevent contact of veneer with inner wall.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment daily.

.2 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Common Work Results for Masonry: Section 04 05 00
.2 Masonry Mortar & Grout: Section 04 05 12
.3 Masonry Anchorage & Reinforcing: Section 04 05 19
.4 Masonry Accessories: Section 04 05 23

1.2 REFERENCES

.1 ASTM International Inc.
  .1 ASTM E336-07, Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings.
.2 Canadian Standards Association (CSA International)
  .1 CAN/CSA-A165 Series-2004, CSA Standards on Concrete Masonry Units, covers: A165.1, A165.2, A165.3.
  .2 CAN/CSA A371-04, Masonry Construction for Buildings.
  .3 CSA S304.1-04, Design of Masonry Structures.
.3 Underwriters' Laboratories of Canada (ULC)
  .1 CAN/ULC-S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Product Data: provide product data, including manufacturer's printed data sheets and catalog pages illustrating products to be incorporated into project for specified products.
.3 Samples:
  .1 Provide unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry
  .2 Manufacturer's Written Instructions: provide in accordance with Section 04 05 00 - Common Work Results for Masonry.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance 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.
  .1 Offload concrete unit and stone masonry packages using equipment that shall not damage the surfaces.
  Do not use brick tongs to move or handle masonry.
.3 Storage and Handling Requirements:
  .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Do not double stack cubes of concrete unit or stone masonry.
  .3 Cover masonry and stone units with non-staining waterproof membrane covering.
  .4 Allow air circulation around units.
  .5 Installation of wet or stained masonry units is prohibited.
  .6 Keep concrete or stone unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.
  .7 Store and protect [concrete unit masonry] from [nicks, scratches, and blemishes].
  .8 Replace defective or damaged materials with new.
.4 Packaging Waste Management:
  .1 Separate and recycle waste materials.

Part 2 Products

2.1 MATERIALS

.1 Masonry Sills: Smooth Precast Concrete Sill with Light Sandblast Finish. Refer to drawings for sizes. Colour to be approved by Owner from Manufacturer's Full standard colour range. Acceptable Products:
- .1 Ed's Concrete Products
- .2 or approved alternate

.2 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
- .1 Classification: H/15/A/M.
- .2 Dimensions – Imperial sizing - Refer to Drawings for nominal sizes.
- .3 Special shapes: provide bull-nosed units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.

.3 Split Face Block: 8x16 nominal
- .1 Acceptable Products
  - .1 Architectural Block by Santerra, Colour: Ebony Black
  - .2 Or approved alternate

2.2 REINFORCEMENT

.1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage & Reinforcing.

2.3 CONNECTORS

.1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage & Reinforcing.

2.4 MORTAR MIXES

.1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortar & Grout.

2.5 GROUT MIXES

.1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

2.6 CLEANING COMPOUNDS

.1 Use low VOC products.

.2 Compatible with substrate and acceptable to masonry manufacturer for use on products.

.3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.7 TOLERANCES

.1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA A165.1, supplemented as follows:
- .1 Maximum variation between units within specific job lot not to exceed 2 mm.
- .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
- .3 Out of square tolerance not to exceed 2 mm.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete unit masonry installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Consultant.
- .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 PREPARATION

.1 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

.1 Concrete block units:
- .1 Bond: running.
- .2 Coursing height: 8” for one block and one joint.
- .3 Jointing: concave 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.
- .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 as indicated on drawings.

3.4 REINFORCEMENT

.1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage & Reinforcing.

3.5 CONNECTORS

.1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage & Reinforcing.

3.6 MORTAR PLACEMENT

.1 Place mortar in accordance with Section 04 05 12 - Masonry Mortar & Grout.

3.7 GROUT PLACEMENT

.1 Place grout in accordance with Section 04 05 12 - Masonry Mortar & Grout.

3.8 CONSTRUCTION

.1 Cull out masonry units, in accordance with CAN/CSA A165, with chips, cracks, broken corners, excessive colour and texture variation.

.2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.

.3 Construct masonry walls using running bond unless otherwise noted.

.4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.

.5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.

.6 Install movement joints and keep free of mortar where indicated.

.7 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.

.8 Tamp units firmly into place.

.9 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.

.10 Tool exposed joints concave; strike concealed joints flush.

.11 After mortar has achieved initial set up, tool joints.

.12 Do not interrupt bond below or above openings.

3.9 REPAIR/RESTORATION

.1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.10 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning, supplemented as follows.

.1 Progress Cleaning:

.1 Standard Concrete Unit Masonry: Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.

.2 Stone Veneer: in accordance with stone manufacturer's instructions.

.3 Architectural Split Face and Stone type block: in accordance with manufacturer's instructions.

.2 Waste Management: separate waste materials for reuse and recycling.

3.11 PROTECTION

.1 Brace and protect concrete masonry in accordance with Section 04 05 00 - Common Work Results for Masonry.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 30 00 Cast-In-Place Concrete

.2 Section 05 50 00 Metal Fabrications

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A36/A36M-19, Standard Specification for Carbon Structural Steel.

.2 ASTM A193/A193M-20, Standard Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.

.3 ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.4 ASTM A325-07a, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

.5 ASTM A325-08, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength.

.6 ASTM A490-04ae, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-85.10-99, Protective Coatings for Metals.

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).

.1 Handbook of the Canadian Institute of Steel Construction.

.2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.

.4 CSA Group (CSA)

.1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CSA-S16-19, Limit States Design of Steel Structures.

.4 CAN/CSA-S136-16, North American Specifications for the Design of Cold Formed Steel Structural Members.

.5 CSA W47.1-19, Certification of Companies for Fusion Welding of Steel.

.6 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.

.7 CSA W55.3-08 (2013), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.8 CSA W59-18, Welded Steel Construction (Metal Arc Welding).

.5 Master Painters Institute (MPI)

.1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.

.2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.

.6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International

.1 NACE No. 3/SSPC SP-6-07, Commercial Blast Cleaning.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 Submittal Procedures.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by Professional Engineer licensed in the Province of Ontario.

.3 Erection drawings:

.1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:

.1 Description of methods.

.2 Sequence of erection.

.3 Type of equipment used in erection.

.4 Temporary bracings.

.4 Fabrication drawings:

.1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified Professional Engineer licensed in the Province of Ontario.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 Common Product Requirements.

.2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CAN/CSA S16 to resist forces, moments, shears and allow for movements indicated.

.2 Shear connections:

.1 Select framed beam shear connections from an industry accepted publication such as the Handbook of the Canadian Institute of Steel Construction when connection for shear only (standard connection) is required.

.2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

.3 Submit sketches and design calculations stamped and signed by qualified Professional Engineer licensed in the Province of Ontario for non-standard connections.

2.2 MATERIALS

.1 Structural steel: to CSA-G40.20/G40.21, Grade 350W.

.2 Structural steel plate, angles and channels: to CSA-G40.20/G40.21, Grade 300W.

.3 Hollow Structural Sections (HSS): to CSA-G40.21/G40.21, Grade 350W, Class 'C'.

.4 Anchor bolts: to CSA-G40.20/G40.21, Grade 300W.

.5 Bolts, nuts and washers: to ASTM A325.

.6 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.

.7 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m^2.

2.3 FABRICATION

.1 Fabricate structural steel in accordance with CAN/CSA S16 and in accordance with reviewed shop drawings.

.2 Continuously seal members by continuous welds. Grind smooth.

2.4 SHOP PAINTING

.1 Clean, prepare surfaces and shop prime structural steel in accordance with MPI EXT 5.1.

.2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to SSPC-SP-3.

.3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 2.5 to 3.5 mils, except:

.1 Surfaces to be encased in concrete.

.2 Surfaces to receive field installed stud shear connections.

.3 Surfaces and edges to be field welded.

.4 Faying surfaces of slip-critical connections.

.5 Below grade surfaces in contact with soil.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.

.5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 Execution

3.1 GENERAL

.1 Structural steel work: in accordance with CAN/CSA S16.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 MARKING

.1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

.2 Match marking: shop mark for fit and match.

3.3 ERECTION

.1 Erect structural steel, as indicated and in accordance with CAN/CSA S16 and in accordance with reviewed erection drawings.

.2 Field cutting or altering structural members: to approval of Consultant.

.3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.4 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory retained by the Contractor.

.2 Provide safe access and working areas for testing on site, as required by testing agency.

.3 Submit test reports to Consultant within 1 week of completion of inspection.

.4 Contractor will pay costs of tests as specified in Section 01 21 00 Allowances.

3.5 FIELD PAINTING

.1 Touch up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6 except as specified otherwise.

.2 Apply in accordance: MPI EXT 5.1.

3.6 CLEANING

.1 Clean in accordance with Section 01 74 11 Cleaning.

End of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 04 05 00 Common Work Results for Masonry

.2 Section 05 12 23 Structural Steel for Buildings.

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A269M-15a, Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.

.3 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 CSA Group (CSA)

.1 CSA G40.20/G40.21-14, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S16-19, Design of Steel Structures.

.4 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.

.5 CSA W59-19, Welded Steel Construction (Metal Arc Welding).

.3 The Master Painters Institute (MPI)

.1 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.

.4 Underwriters Laboratories (UL)

.1 UL 2768-11, Architectural Surface Coatings

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 Submittal Procedures.

.2 Shop Drawings:

.1 Submit drawings stamped and signed by Professional Engineer licensed in the Province of Ontario.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Structural steel: to CSA-G40.20/G40.21, Grade 350W.

.2 Steel plates, angles, and channels: to CSA G40.20/G40.21, Grade 300W.

.3 Hollow Structural Sections (HSS): to CSA G40.20/G40.21, Grade 350W, Class 'C'.

.4 Steel pipe: to ASTM A53/A53M standard weight.

.5 Welding materials: to CSA W59.

.6 Welding electrodes: to CSA W48 Series.

.7 Bolts and anchor bolts: to ASTM A307.

.8 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2 to CAN/CSA-G164.

.2 Zinc primer: zinc rich, ready mix to MPI-EXT 5.2C.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

2.5 SHOP PAINTING

.1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Paint when temperature minimum 7 degrees C.

.3 Clean surfaces to be field welded; do not paint.

2.6 LINTELS

.1 Beams and plates: prime painted, sizes indicated for openings. Provide 8” minimum bearing at ends.

.2 Steel angles: prime painted, sizes indicated for openings. Provide 8” minimum bearing at ends.

.1 Weld or bolt back-to-back angles to profiles as indicated.

.3 Finish: shop painted.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal fabrications installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions remedied.

3.2 ERECTION - GENERAL

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CSA S16.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.8 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 Cleaning.

.1 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.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

End of Section

Part 1 Structural Steel for BuildingsGeneral

1.1 RELATED REQUIREMENTS

.1 Painting: Section 09 90 00
.2 Metal Ladder: Section 05 51 33

1.2 REFERENCES

.1 ASTM International
  .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
.2 CSA International
  .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  .2 CSA S16-09, Design of Steel Structures.
  .3 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding)
.3 The Master Painters Institute (MPI)
  .1 Architectural Painting Specification Manual - current edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, bolts and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Shop Drawings:
  .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 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.
.3 Storage and Handling Requirements:
  .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.
.4 Packaging Waste Management: remove for reuse and/or recycling.

Part 2 Products

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W.
.2 Steel pipe: to ASTM A53/A53M standard weight. black finish.
.3 Welding materials: to CSA W59.
.4 Welding electrodes: to CSA W48 Series.
.5 Bolts and anchor bolts: to ASTM A307.
.6 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Shop coat primer: MPI - INT & EXT 5.1A; quick dry enamel semi-gloss finish.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

2.5 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum.

.2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.

.4 Clean surfaces to be field welded; do not paint.

2.6 LADDER

.1 Refer to drawings for custom ladder fabrication.

.2 Shop coat prime ladders after fabrication and finish to Section 09 90 00 – Painting.

.3 Refer to specification section 05 51 33 – Metal Ladders for approved pre-manufactured ladder alternate.

2.7 PIPE RAILINGS

.1 Steel pipe: 30 to 40 mm nominal outside diameter for handrails. For other handrails, formed to shapes and sizes as indicated.

.2 Shop coat prime interior railings after fabrication. Apply high build epoxy coating after fabrication. Shop coat prime exterior railings after fabrication and finish to Section 09 90 00 – Painting.

2.8 ANGLE LINTELS

.1 Steel angles: prime painted, sizes indicated for openings. Provide 6” (150 mm) minimum bearing at ends.

.2 Weld or bolt back-to-back angles to profiles as indicated.

.3 Finish: shop painted

.1 Primer: VOC limit 250 g/L maximum when applied on site.

2.9 PIPE BOLLARDS

.1 Steel 8 inch diameter, 3/8 in. in wall thickness steel pipe bollard . Length and details as indicated on drawings. Provide concrete between hole and pipe and fill pipe with concrete after installation. Crown top and steel trowel. Paint finish. Provide reinforcing as required.

2.10 GRATING

.1 Steel Grating: Steel grating shall be weld forged welded rectangular design type WD as manufactured by IKG Industries or equivalent by Accurate Screen & Grating. Main bearing bars. Cross bars to be resistance welded at right angles to the bearing bars.

They shall be spaced 4 inches o.c. No notching or cutting of bearing bars before welding is permissible. Grating is to safely sustain a uniformly distributed load of 250 lb / sq ft on a 48 inch span and deflect less than .250 inches. Finish: galvanized. Overall dimensions, details and direction of bearing bars in accordance manufacturer's specifications. All grating to be banded and matched. Provide tamper proof removable hold down clips on exterior applications. See structural drawings for bearing bars and support.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CSA S16 or Weld field connection.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
- .1 Primer: maximum VOC limit 250 g/L.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
- .1 Primer: maximum VOC limit 250 g/L.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 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.

.3 Waste Management: separate waste materials for reuse and recycling.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

End Of Section

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute/National Particleboard Association (ANSI/NPA)

.1 ANSI/NPA A208.1-2009, Particleboard.

.2 ASTM International

.1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM C578-11a, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

.4 ASTM C1289-11, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

.5 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.

.6 ASTM D1761-06, Standard Test Methods for Mechanical Fasteners in Wood.

.7 ASTM D5055-11, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.

.8 ASTM D5456-10a, Standard Specification for Evaluation of Structural Composite Lumber Products.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-11.3-M87, Hardboard.

.2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

.3 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.

.4 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.

.4 CSA International

.1 CSA O86-14 Engineered Design in Wood

.2 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.

.3 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).

.4 CSA O121-08, Douglas Fir Plywood.

.5 CSA O141-05 (R2009), Softwood Lumber.

.6 CSA O151-09, Canadian Softwood Plywood.

.7 CSA O153-M1980 (R2008), Poplar Plywood.

.8 CSA O325-07, Construction Sheathing.

.9 CSA-O437 Series-93, Standards on OSB and Waferboard

.10 CSA O452 Series-94, Design Rated OSB

.11 CAN/CSA-Z809-08, Sustainable Forest Management.

.5 Forest Stewardship Council (FSC)

.1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.

.6 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2010.

.7 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

.8 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by Professional Engineer licensed in the Province of Ontario.

.2 Wood Certification: submit manufacturer's Chain-of-Custody Certificate number for CAN/CSA-Z809 or FSC or SFI certified wood.

.3 Low-Emitting Materials:

.1 Submit listing of adhesives and sealants used in building, showing compliance with VOC and chemical component limits or restriction requirements.

.2 Submit listing of composite wood products used in building, stating that they contain no added urea-formaldehyde resins.

1.3 QUALITY ASSURANCE

.1 Installer Qualifications: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

.2 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from 1 source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers

.3 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.4 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

.5 Sustainable Standards Certification:

.1 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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.

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect wood from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

.1 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:

.1 CSA O141.

.2 NLGA Standard Grading Rules for Canadian Lumber.

.2 Glued end-jointed (finger-jointed) lumber NLGA Special Products Standard SPS, are acceptable.

.3 Wood I-joists in accordance with Prefabricated Wood I-Joists ASTM D5055.

.4 Structural Composite Lumber (SCL) in accordance with ASTM D5456.

.5 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:

.1 Board sizes: "Standard" or better grade.

.2 Dimension sizes: "Standard" light framing or better grade.

.3 Post and timbers sizes: "Standard" or better grade.

.6 Plywood, OSB and wood based composite panels: to CSA O325.

.7 Douglas fir plywood (DFP): to CSA O121, standard construction.

.8 Canadian softwood plywood (CSP): to CSA O151, standard construction.

.9 Poplar plywood (PP): to CSA O153, standard construction.

2.2 ACCESSORIES

.1 General purpose adhesive: to CSA O112.9.

.2 Nails, spikes, and staples: to CSA B111.

.3 Bolts: 1/2” diameter unless indicated otherwise, complete with nuts and washers, to ASTM A307.

.4 Threaded Rod: 1/2” diameter unless indicated otherwise, complete with nuts and washers, to ASTM A193 grade B7.

.5 Joist hangers: minimum 22 ga. sheet steel, galvanized ZF001 coating designation.

.6 Nailing discs: flat caps, minimum 1” diameter, minimum 0.4 mm thick, sheet metal, formed to prevent dishing. Bell or cup shapes not acceptable.

.7 Fastener Finishes:

.1 Galvanizing: to ASTM A123/A123M, use galvanized fasteners.

.8 Wood Preservative:

.1 Preservative: in accordance with manufacturer's recommendations for surface conditions.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.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 PREPARATION

.1 Treat surfaces of material with wood preservative before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3-minute soak on lumber and one-minute soak on plywood.

.3 Re-treat surfaces exposed by cutting, trimming, or boring with liberal brush application of preservative before installation.

.4 Treat material as indicated.

3.3 MATERIAL USAGE

.1 Roof sheathing:

.1 Plywood, DFP or CSP sheathing grade or PP standard sheathing grade, square edge

.2 Construction sheathing product: end use mark R24

.2 Electrical equipment mounting boards:

.1 NBC Compliant Pressure-Impregnated FRTW;

.2 Flame retardant 3/4” fir plywood, ULC certified, ASTM E84;

.3 Product: Refer to Section 06 20 00 Finish Carpentry.

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 spanning members with "crown-edge" up.

.4 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding, electrical equipment mounting boards and other work as required.

.5 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.

.1 Align and plumb faces of furring and blocking to tolerance of 1:600.

.6 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.7 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.

.8 Install sleepers as indicated.

.9 Use dust collectors and high-quality respirator masks when cutting or sanding wood panels.

.10 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.11 Countersink bolts where necessary to provide clearance for other work.

.12 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 Cleaning.

.1 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.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by rough carpentry installation.

End of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Rough Carpentry: Section 06 10 00
.2 Door Hardware: Section 08 71 00

1.2 REFERENCES

.1 American National Standards Institute (ANSI)
  .1 ANSI/HPVA HP-1-2004, American National Standard for Hardwood and Decorative Plywood.
.2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
  .1 Architectural Woodwork Quality Standards, 1st edition, 2009.
.3 CSA International
  .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  .2 CSA O121- R2008, Douglas Fir Plywood.
  .3 CSA O141-05(R09), Softwood Lumber.
  .4 CSA O151-09, Canadian Softwood Plywood.
.4 National Lumber Grades Authority (NLGA)
  .1 NLGA Standard Grading Rules for Canadian Lumber 2014.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Shop Drawings:
  .1 Submit drawings indicating details of construction, profiles, jointing, fastening and other related details.
  .2 Indicate materials, thicknesses, finishes and hardware.

1.4 QUALITY ASSURANCE

.1 Lumber by grade stamp of agency certified by Canadian Lumber Standards Accreditation Board (CLSAB).
.2 Plywood, particleboard, OSB and wood based composite panels to CSA and ANSI standards.
.3 Wood fire rated frames and panels: listed and labelled by an organization accredited by Standards Council of Canada to CAN4-S104 and CAN/ULC-S105.

1.5 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 Storage and Handling Requirements:
  .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect wood products from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.
.3 Packaging Waste Management: remove for reuse and recycling.

Part 2 Products

2.1 MATERIALS

.1 Softwood lumber: S4S, moisture content 19% or less in accordance with following standards:
  .1 CSA O141.
  .2 NLGA Standard Grading Rules for Canadian Lumber.
  .3 AWMAC custom grade, moisture content as specified.
  .4 Machine stress-rated lumber is acceptable.

2.2 ACCESSORIES

.1 Nails and staples: to CSA B111; galvanized to CAN/CSA-G164 for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.

.2 Wood screws: plain, type and size to suit application.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for wood products installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.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 Do finish carpentry to Quality Standards of (AWMAC).

.2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.

.3 Form joints to conceal shrinkage.

3.3 CONSTRUCTION

.1 Fastening:

.1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

.2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.

.3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round smooth cut hole and plug with wood plug to match material being secured.

.4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.

.2 Hardware:

.1 Install door hardware in accordance with manufacturer’s instructions and templates.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon substantial completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by finish carpentry installation.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Rough Carpentry: Section 06 10 00

1.2 REFERENCES

.1 American National Standards Institute (ANSI)
- .1 ANSI/NPA A208.1-09, Particleboard.

.2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
- .1 Architectural Woodwork Quality Standards Illustrated, 8th edition, Version 1.0 (2009).

.3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.

.4 CSA International
- .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
- .2 CSA O112.4 SERIES-M1977(R2006), Standards for Wood Adhesives.
- .3 CSA O141-05, Softwood Lumber.
- .4 CSA O151-09, Canadian Softwood Plywood.
- .5 CSA O153-M1980(R2008), Poplar Plywood.

.5 National Electrical Manufacturers Association (NEMA)
- .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).

.6 National Lumber Grades Authority (NLGA)
- .1 Standard Grading Rules for Canadian Lumber 2014.

.7 ANSI/BMHA A156.9-1994, American National Standard for Cabinet Hardware.

1.3 DESIGN REQUIREMENTS

.1 Ensure millwork casework (e.g. countertops, wall cabinets, cabinet drawers and similar items) are capable of supporting structural loads without deflection in accordance with Casework Integrity Tests in Appendix A of AWS. Without limitations, in particular ensure:
- .1 millwork counter top and vanities, capable structural integrity of supporting 907 kg (2000 lb)
- .2 Kitchen areas:0.718 Kilopascals (15 psf)
- .3 Closet shelves: 1.197 Kilopascals (25 psf)
- .4 Bookshelves:1.915 Kilopascals (40 psf) load as per AWS Casework Integrity Tests AWS Appendix A
- .5 Minimum nominal thickness and material for cabinet components and shelf deflection, type of materials, thicknesses, span width and total load distribution shall be in accordance with Architectural Woodwork Standards Section 10.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for architectural woodwork and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit copies of WHMIS SDS.

.3 Shop Drawings:
- .1 Submit Shop Drawings indicating material characteristics, details of construction, connections and relationship with adjacent construction.
- .2 Clearly indicate material being supplied and show locations and sizes of furring, blocking, connections, attachments, reinforcing, anchorage and location of exposed fastenings in accordance with AWS Section 1. Include concealed blocking and reinforcement specified in other Sections.

.3 Show locations and sizes of cutouts and holes for plumbing and electrical fixtures, lavatories and other items required to be installed in architectural woodwork. Coordinate with appropriate trades.

.4 Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication to ensure proper fitting of work. Do not proceed with fabrication until Shop Drawings have been returned and stamped as reviewed by Consultant.

.4 Closeout Submittals:

.1 Provide manual, detailing maintenance procedure for finishes requiring specific care, noting particularly those procedures or materials which shall cause damage to finished surfaces.

1.5 SAMPLES

.1 Submit for review and acceptance of each unit, panel, and hardware.

.2 Submit duplicate samples of laminated plastic for colour selection.

.3 Submit duplicate samples of laminated plastic joints, edging, cutouts and postformed profiles.

.4 Submit duplicate samples of solid surface.

.5 Submit one of each type of hardware.

.6 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.6 QUALITY ASSURANCE

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

.2 Plywood, particleboard, OSB and wood based composite panels to CSA and ANSI standards.

.3 Source Limitations: engage qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork and one manufacturer's product.

.4 Mock-ups:

.1 Construct mock-up in accordance with Section 01 45 00 Quality Control.

.2 Shop prepare one room complete with base counters, wall cabinets, counter tops, shelving units and associated hardware and install in room as directed by the Consultant and Owner.

.3 Allow 48 hours for inspection of mock-up by Consultant and Owner before proceeding with Work.

.4 When accepted, mock-up shall demonstrate minimum standard for Work.

.5 Mock-up may remain as part of finished work.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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.

.1 Protect millwork against dampness and damage during and after delivery.

.2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect architectural woodwork from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.8 WARRANTY

.1 Warrant Work of this Section for period of 2 years against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct defects or

deficiencies which become apparent within warranty period, to satisfaction of Owner and Consultant and at no additional expense. Defects include but are not limited to: delamination of plastic laminate, opening of seams, and extensive colour fading.

Part 2 Products

2.1 LUMBER, GENERAL

.1 Materials: to AWMAC Manual, except where otherwise specified.
- .1 Framing lumber: specified species, no. 1 grade, S4S.

.2 Moisture Content: between 4-9%.

2.2 MATERIALS

.1 Provide panel products manufactured with phenol-formaldehyde or, if available, formaldehyde-free adhesive.

.2 Materials and Moisture Content: to AWMAC Manual, except where otherwise specified.

.3 Particleboard: to ANSI A208.1-1999, grade M-3, sanded faces, minimum density 43 lb./ft³ (720 kg/m^3).

.4 Softwood Plywood: to applicable CSA standards referenced in AWMAC Manual, G2S.

.5 Tempered Hardboard: to CAN/CGSB-11.3-M87, Type 2, minimum density of 476 kg/m^3.

.6 Thermofused Laminate: to NEMA LD3 Grade VGL.
- .1 High wear resistant thermofused Laminate: equal or exceed 400 cycles (Minimum standard for HPL abrasion test).
- .2 Work of this section shall be provided by one of the following manufacturer's
  - .1 Design Based on Unibord
    all other manufactures to comply with all aspects of this specifications including selection of similar colour / texture / finish. **The onus is on the supplier to confirm matching finishes.**
    - .2 Tafisia
    - .3 Mercury Wood Products
    - .4 or approved alternate
- .3 Acceptable Product:
  - .1 MF1 – Unibord Riviera Oak Series, Monaco K18
  - .2 or approved alternate.

.7 High Pressure Laminate: to NEMA LD 3.
- .1 Type: Postforming & Self Edge.
- .2 Grade: HGP.
- .3 Size: 1.0 mm thick.
- .4 Work of this section shall be provided by one of the following manufacturer's
  - .1 Design Based on Wilsonart
    all other manufactures to comply with all aspects of this specifications including selection of similar colour / texture / finish. **The onus is on the supplier to confirm matching finishes.**
    - .2 Uniboard
    - .3 Mercury Wood Products
    - .4 Formica
    - .5 Tafisia
    - .4 or approved alternate
- .5 Acceptable Product:
  - .1 Wilsonart
    - .1 MF2 Colour: Silver Travertine 1858K-55
    - .2 WS1 Colour: Crystal D388-60 Matte
    - .3 Or approved alternate

.8 Nails and staples: to CSA B111.

.9 Wood screws: type and size to suit application.

.10 Splines & Draw Bolts: as recommended by manufacturer.

.11 Sealant:

.1 Seal junction of countertops and painted surfaces with One component, paintable acrylic latex sealant meeting the specified requirements of specification CGSB-19-GP-17M. Tremflex 834 by Tremco Ltd.
.2 or approved alternate.

2.3 HARDWARE

.1 Cabinet hardware: to ANSI/BNMA A156.9, and as indicated on drawings.
.1 Hinges: European style hinge with 110° swing of operation for face frame construction cabinets, nickel plated finish.
.2 Pulls: Cabinet Door and Drawer Pulls: stainless steel with #170 finish:
.1 Pulls are Based on Richelieu. Refer to drawings for type.
.2 Or approved alternate
.3 Latches: elbow latch.
.4 Catches: friction catch.
.5 Shelf Rest: Support 13/64" long with integral pin 1/4" diameter x 5/16" long, and support 5/16" dia. x 1/2" long, nickel plated steel finish. Richelieu CP128180 or approved alternate. Drawer slides: side mounted drawer slides.
.6 Drawer Track and guides: full extension, self closing, side mounted, zinc coated finish, length to suit installation.
.7 Door Bumpers: neoprene, self adhesive type
.2 Cabinet locks: to ANSI/BNMA A156.11, refer to drawings for locations.
.1 Door or drawer locks: half mortised into back of door or drawer
.2 Cylinders: key to keying system as directed

2.4 MANUFACTURED UNITS

.1 Casework; TFL Faced:
.1 Fabricate caseworks to AWMAC custom quality grade.
.2 Furring, blocking, nailing strips, grounds and rough bucks and sleepers.
.1 S2S is acceptable.
.2 Board sizes: "standard" or better grade.
.3 Dimension sizes: "standard" light framing or better grade.
.4 Urea-formaldehyde free.
.3 Framing SPF species.
.4 Case bodies (ends, divisions and bottoms).
.1 TFL finished, Particleboard core, refer to drawings for thickness
.5 Backs:,
.1 Hardboard, TFL finished, refer to drawings for thickness
.6 Shelving:
.1 Particleboard, 1" (25.4 mm) thick, with TFL finish on all sides and edges.
.3 Drawers and Doors:
.1 Fabricate drawers and doors to AWMAC custom grade supplemented as follows:
.2 Drawer Fronts, Bottoms, Sides and Backs and Door Fronts.
.1 Particleboard, TFL finished, refer to drawings for thickness
.4 Bases: refer to drawings for base materials.

2.5 FABRICATION

.1 Shop install cabinet hardware for doors, shelves and drawers.
.2 Shelving to cabinetwork to be adjustable unless otherwise noted.
.3 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
.4 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
.5 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
.6 Ensure adjacent parts of continuous melamine or laminate work matches in colour and
.7 direction of pattern.

.8 Use straight matching melamine laminate strip for flatwork to cover exposed edge of core material.

.9 Form shaped profiles and bends as indicated, using postforming grade laminate to laminate manufacturer's instructions.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Cover finished surfaces with heavy kraft paper or put in cartons during shipment.

.2 Protect installed surfaces in accordance with manufacturer's written recommendations.

.3 Remove protection only immediately before final inspection.

.4 Protect installed products and components from damage during construction.

.5 Repair damage to adjacent materials caused by installation of work of this section.

3.2 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.

.1 Visually inspect substrate.

.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.

3.3 INSTALLATION

.1 Do architectural woodwork to Quality Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC).

.2 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb and straight.

.3 Fasten and anchor millwork securely. Supply and install heavy duty fixture attachments for wall mounted cabinets.

.4 Use draw bolts in laminated plastic countertop joints.

.5 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.

.6 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of paintable sealant in accordance with manufacturer's instructions.

.7 Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.

.8 Fit hardware accurately and securely in accordance with manufacturer's written instructions.

3.4 CLEANING

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion of this secion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 77 00 – Closeout Requirements and Final Cleaning.

.1 Clean millwork and cabinet work inside cupboards and drawers and outside surfaces.

.2 Remove excess glue from surfaces.

3.5 PROTECTION

.1 Protect millwork and cabinet work from damage until final inspection.

.2 Protect installed products and components from damage during construction.

.3 Repair damage to adjacent materials caused by architectural woodwork installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)
  .1 ANSI/NPA A208.1-09, Particleboard.
.2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
  .1 Architectural Woodwork Quality Standards Illustrated, 8th edition, Version 1.0 (2009).
.3 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
.4 CSA International
  .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
  .2 CSA O112.4 SERIES-M1977(R2006), Standards for Wood Adhesives.
  .3 CSA O141-05, Softwood Lumber.
  .4 CSA O151-09, Canadian Softwood Plywood.
  .5 CSA O153-M1980(R2008), Poplar Plywood.
.5 National Electrical Manufacturers Association (NEMA)
  .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).
.6 National Lumber Grades Authority (NLGA)
  .1 Standard Grading Rules for Canadian Lumber 2014.
.7 ANSI/BMHA A156.9-1994, American National Standard for Cabinet Hardware.

1.2 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for architectural woodwork and include product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit copies of WHMIS SDS.
.3 Shop Drawings:
  .1 Submit Shop Drawings indicating material characteristics, details of construction, connections and relationship with adjacent construction.
  .2 Clearly indicate material being supplied and show locations and sizes of furring, blocking, connections, attachments, reinforcing, anchorage and location of exposed fastenings in accordance with AWS Section 1. Include concealed blocking and reinforcement specified in other Sections.
  .4 Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication to ensure proper fitting of work. Do not proceed with fabrication until Shop Drawings have been returned as reviewed by Consultant.
.4 Closeout Submittals:
  .1 Provide manual, detailing maintenance procedure for finishes requiring specific care, noting particularly those procedures or materials which shall cause damage to finished surfaces.

1.3 SAMPLES

.1 Submit for review and acceptance of each colour sample.

1.4 QUALITY ASSURANCE

.1 Source Limitations: engage qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork and one manufacturer's product.
.2 Mock-ups:
  .1 Construct mock-up in accordance with Section 01 45 00 Quality Control.
  .2 When accepted, mock-up shall demonstrate minimum standard for Work.
  .3 Mock-up may remain as part of finished work.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect architectural woodwork from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.6 WARRANTY

.1 Warrant Work of this Section for period of 2 year against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no additional expense. Defects include but are not limited to: delamination of plastic laminate, opening of seams, and extensive colour fading.

Part 2 Products

2.1 SOLID SURFACE COUNTER TOPS

.1 12.5 mm thick homogenous sheet composed of a blend of natural minerals and 100% acrylic resin to ANSI Z124.3 and Z124.6 Type 6,

.1 Acceptable Products:

.1 Wilsonart, Colour: Yukon Riverstone 9196RS

.2 or approved alternate

.2 Joint and Laminating adhesive: solid surface manufacturer’s standard

.3 Adhesive for Bonding Solid Surfacing to other materials: silicone sealant to ASTM C920

.4 front edge: eased

Part 3 Execution

3.1 MANUFACTURER’S INSTRUCTIONS

.1 Cover finished surfaces with heavy kraft paper or put in cartons during shipment.

.2 Protect installed surfaces in accordance with manufacturer's written recommendations.

.3 Remove protection only immediately before final inspection.

.4 Protect installed products and components from damage during construction.

.5 Repair damage to adjacent materials caused by installation of work of this section.

3.2 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.

.1 Visually inspect substrate.

.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.

3.3 INSTALLATION

.1 Install prefinished sills shown on drawings. Position accurately, level, plumb and straight.

.2 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.

3.4 CLEANING

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion of this section remove surplus materials, rubbish, tools and equipment in accordance with Section 01 77 00 – Closeout Requirements and Final Cleaning.

.1 Clean millwork and cabinet work inside cupboards and drawers and outside surfaces.

.2 Remove excess glue from surfaces.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Cast In Place Concrete: Section 03 30 00

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CGSB 71-GP-24M-77(R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.

.2 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.

1.3 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit two copies of WHMIS SDS - Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Manufacturer's Instructions:
- .1 Submit manufacturer's installation instructions.

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 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

Part 2 Products

2.1 INSULATION

.1 Extruded polystyrene (SM): to CAN/ULC-S701.
- .1 Type: 4.
- .2 Thickness: as indicated.
- .3 Size: maximum practical size to suit installation.
- .4 Edges: square.

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 WORKMANSHIP

.1 Install insulation after building substrate materials are dry.

.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.3 Fit insulation tight around protrusions.

.4 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.5 Do not enclose insulation until it has been inspected and approved in writting by Consultant.

3.3 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.

3.4 PERIMETER FOUNDATION INSULATION

.1 Interior application: extend boards as indicated, horizontally and vertically, installed on inside face of perimeter foundation walls.

3.5 UNDER HEAT CONCRETE SLAB INSULATION

.1 Install insulation to manufacturer's recommendations.

3.6 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 10 00: Rough Carpentry

.2 Section 09 21 16: Gypsum Board Assemblies

1.2 REFERENCES

.1 ASTM C665-01e Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.2 ASTM C1320-05, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.

.2 Canadian Standards Association (CSA International)

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S702-1997, Standard for Mineral Fibre Insulation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

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.

.3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse or recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

Part 2 Products

2.1 INSULATION

.1 Acoustical and fire batt insulation for walls and floors to CAN/ULC S702, Type 1.

.1 Fire performance:

.1 Non-combustibility: To CAN/ULC S114.

.2 Surface Burning Characteristics: To CAN/ULC S102.

.1 Flame spread: 0.

.2 Smoke developed: 0

.3 Smoulder resistance: 0.09% to CAN/ULC S129.

.2 Acoustical Performance:

.1 Airborne sound transmission loss: To ASTM E90.

.2 Rating sound insulation: To ASTM E413.

.3 Sound absorption co-efficients: To ASTM C423.

.3 Refer to drawings for thickness required

.4 Acceptable Product:

.1 Rockwool AFB

.2 Owens Corning Thermafiber SAFB

.3 or approved alternate

2.2 ACCESSORIES

.1 Nails: galvanized steel, length to suit insulation plus 1" (25 mm), to CSA B111.
.2 Staples: ½" (12 mm) minimum leg.
.3 Tape: as recommended by manufacturer.

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 INSULATION INSTALLATION

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to provide sound attenuation.
.2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
.3 Do not compress insulation to fit into spaces.
.4 Keep insulation minimum 3" (75 mm) from heat emitting devices such as recessed light fixtures, and minimum 2" (50 mm) from CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B vents.
.5 Do not enclose insulation until it has been inspected and approved by Consultant.

3.3 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

End Of Section

Part 1 General

1.1 RELATED SECTIONS

.1 Section 07 21 29 – Sprayed insulation - Polyurethane Foam

1.2 REFERENCES

.1 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)

.2 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S101, Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S705.1, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Material Specification.

.4 CAN/ULC-S705.2, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Installer's Responsibilities-Specification.

1.3 TEST REPORTS

.1 Submit test reports, verifying qualities of foam sealant meet or exceed requirements of this specification.

.2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.

1.4 QUALITY ASSURANCE

.1 Applicators to conform to CUFCA Quality Assurance Program.

1.5 SAFETY REQUIREMENTS

.1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:

.1 Workers must wear gloves, respirators, dust masks, eye protection, protective clothing when applying foam sealant.

.2 Workers must not eat, drink or smoke while applying foam sealant.

1.6 PROTECTION

.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 Dispose of waste foam sealant daily in location designated by Owner’s Representative and decontaminate empty drums in accordance with foam sealant manufacturer’s instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Apply foam sealant only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

Part 2 Products

1.1 MATERIALS

.1 Low expanding, one-component, polyurethane foam sealant, curing to a semi-rigid, closed cell urethane foam providing a RSI of 0.9 per 25.4 mm. To meet the following physical properties:

.1 Density: 25.7 kg/m^3

.2	Compressive Strength Parallel @ 10%:	69-96 psi
.3	Tensile Strength:	103 psi
.4	Water Vapour Transmission:	5.97 perms
.5	Flame Spread:	20
.6	Smoke Development:	70

Part 3 Execution

1.1 APPLICATION

.1 Apply foam sealant to clean surfaces in accordance with manufacturer's printed instructions. Surfaces to be free of dust, dirt, oil and other foreign materials.

.2 Cover surfaces not intended to be foamed.

.3 Apply foam sealant to perimeter of openings indicated and to thickness as recommended by manufacturer. Trim excess cured foam from finished area.

.4 Cover exposed urethane foam sealants to protect from adverse effects from ultraviolet light (sunlight).

End Of Section

Part 1 General

1.1 REFERENCES

.1 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S101-04, Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S705.1-01, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification.

.4 CAN/ULC-S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.

1.2 ACTION AND INFORMATIONAL 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 datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies WHMIS SDS - Safety Data Sheets,

.3 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 CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures,

.4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 QUALITY ASSURANCE

.1 Applicators to conform to CUFCA Quality Assurance Program or BASF Canada Quality Assurance Training Program.

.2 Qualifications:

.1 Installer: person specializing in sprayed insulation installations, approved by manufacturer with 5 years experience.

.2 Manufacturer: company with minimum 5 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.

.3 Mock-up:

.1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.

.2 Construct mock-up 100 SF (10 m^2) minimum, of sprayed insulation including one inside corner and one outside corner, door and window openings.

.3 Mock-up may be part of finished work.

.4 Allow 24 hours for inspection of mock-up by Consultant before proceeding with sprayed insulation work.

.4 Health and Safety Requirements: worker protection:

.1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:

.2 Workers must wear gloves, respirators, eye protection, protective clothing when applying foam insulation.
.3 Workers must not eat, drink or smoke while applying foam insulation.

1.4 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.
.2 Waste Management and Disposal:
.1 Separate waste materials for reuse or recycling.

1.5 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 hour 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 manufacturers' prescribed limits.

Part 2 Products

2.1 MATERIALS

.1 Insulation: spray polyurethane to CAN/ULC-S705.1To CAN/ULC S705.1, including amendment 1 & 2 closed cell, spray-applied rigid cellular polyurethane foam air barrier and thermal insulation, medium density:
.1 Thermal Resistance Required: refer to drawings.
.2 Density: 28 kg/m^3, to ASTM D1622.
.3 Air barrier properties: to ASTM E2178.
.1 @75 Pa: maximum 0.05 L/s.
.4 Water Vapour Permeance, to ASTM E96:
.1 50 mm thick: maximum 60 ng/(Pa.s.m^2).
.5 Tensile Strength: minimum 200 kPa, to ASTM D1621.
.6 Flame Spread: to CAN/ULC-S102.
.7 Water Absorption by volume: maximum 4%, to ASTM D2842.
.2 Primers: in accordance with manufacturer's recommendations for surface conditions.
.3 Acceptable Product:
.1 Genyk-Boreal Elite
.2 or approved alternate.

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 APPLICATION

.1 Apply insulation to clean surfaces in accordance with CAN/ULC-S705.2 and manufacturer's printed instructions.
.2 Use primer where recommended by manufacturer.
.3 Apply sprayed foam insulation in thickness to provide RSI value indicated.

3.3 FIELD QUALITY CONTROL

.1 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.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

End Of Section

Part 1 General

1.1 RELATED WORK

.1 Cast In Place Concrete

1.2 RELATED WORK

.1 ASTM D1709 - 09 Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.

.2 ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

.3 ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.

.4 ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

.5 ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

.6 ASTM F1249-01 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

1.3 SUBMITTALS

.1 Comply with Section 01 33 00 - Submittal Procedures.

.2 Submit manufacturer's product data and application instructions.

1.4 QUALITY CONTROL

.1 Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of the vapour retarder.

.2 Obtain vapour retarder materials from a single manufacturer regularly engaged in manufacturing the product.

.3 Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

.2 Store materials in a clean, dry area in accordance with manufacturer's instructions.

.3 Protect materials during handling and application to prevent damage or contamination.

.4 Ensure membrane is stamped with manufacturer’s name, product name, and membrane thickness at intervals of no more than 220cm (85”).

1.6 ENVIROMENTAL REQUIREMENTS

.1 Product not intended for uses subject to abuse or permanent exposure to the elements.

.2 Do not apply on frozen ground.

Part 2 Products

2.1 SHEET VAPOUR BARRIER (UNDER SLAB)

.1 Plastic Vapor Retarder: manufactured from polyolefin resins, tested in accordance with ASTM E1745 having the following performance requirements:

- .1 Maximum Water Vapour Permeance (ASTM E154 Sections 7, 8, 11, 12, 13, by ASTM E96, Method B or ASTM F1249).
  - .1 As received: 0.0183 perms.
  - .2 After Wetting and Drying: 0.0210 perms.
  - .3 Resistance to Plastic Flow and Temperature: 0.0197 perms.
  - .4 Effect Low Temperature and Flexibility: 0.0212 perms.
  - .5 Resistance to Deterioration from Organisms and Substances in Contacting Soil: 0.0198 perms.
- .2 Puncture Resistance (ASTM D1709): >3,500 grams.

.3 Tensile Strength ASTM E154, Section 9: 52 Lb. Force/Inch.
.4 Thickness: 10 mil.
.5 Acceptable Product: W.R. Meadows Perminator or approved alternate.

.2 Accessories:
.1 Seam Tape
1. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4" (100 mm). Acceptable Product: W.R. Meadows Perminator Tape or approved alternate.
.2 Pipe Collars: Construct pipe collars from vapor retarder material and pressure sensitive tape in accordance with membrane manufacturer's instructions.

Part 3 Execution

3.1 UNDER SLAB VAPOUR BARRIER INSTALLATION

.1 Surface Preparation:
.1 Prepare surfaces in accordance with manufacturer's instructions.
.2 Level, tamp, or roll earth or granular material beneath the slab base.

.2 Examine surfaces to receive membrane. Notify Consultant if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

. 3 Application
.1 Install the vapor retarder membrane in accordance with manufacturer's instructions.
.2 Unroll vapor retarder with the longest dimension parallel with the direction of the pour.
.3 Lap vapor retarder over footings and seal to foundation walls.
.4 Overlap joints 6" (150 mm) and seal with manufacturer's tape.
.5 Seal all penetrations (including pipes) with manufacturer's pipe boot.
.6 No penetration of the vapor retarder is allowed except for reinforcing steel and permanent utilities.
.7 Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6" (150 mm) and taping all four sides with tape.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Metal Doors & Frames: Section 08 11 00
.2 Aluminum Window Framing Section 08 11 16

1.2 ACTION AND INFORMATIONAL 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 datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
.3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
.1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse or recycling.

1.5 AMBIENT CONDITIONS

.1 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

Part 2 Products

2.1 SHEET MATERIALS

.1 Primary sheet air/vapour barrier membrane: SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film. For application temperatures down to -12°C use Blueskin® SA LT or approved alternate. Membrane shall have the following physical properties:
.1 Thickness: 1.0 mm (40 mils),
.2 Air leakage: <0.005 L/s.m² @ 75 Pa to ASTM E283-91,
.3 Tested to ASTM E 2357 for the air barrier assembly,
.4 Water vapour permeance: 1.6 ng/Pa.m².s (0.03 perms) to ASTM E96,
.5 Low temperature flexibility: -30 °C to CGSB 37-GP-56M,
.6 Elongation: 200% to ASTM D412-modifed.
.2 Acceptable Products:
.1 Blueskin SA manufactured by Henry-Bakor
.2 Air-Shield manufactured by W.R. Meadows of Canada
.3 Approved Alternate

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 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept work of this section.
.2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
.3 Report unsatisfactory conditions to Consultant.

.4 Do not start work until deficiencies have been corrected.
.1 Beginning of Work implies acceptance of conditions.

3.3 PREPARATION

.1 Remove loose or foreign matter, which might impair adhesion of materials.
.2 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.
.3 Ensure substrates are free of surface moisture prior to application of [self-adhesive] membrane and primer.
.4 Ensure metal closures are free of sharp edges and burrs.
.5 Prime substrate surfaces in accordance with manufacturer's instructions.

3.4 TRANSITION STRIP INSTALLATION

.1 Install materials in accordance with manufacturer's instructions.
.2 Application: Examine substrate to ensure it is smooth, clean, dry and free from loose contaminants. Brush and/or scrape to prepare.
.3 At beam, column, window and door locations, tie in surfaces with Transition Strip lapped a minimum of 6" on both substrates.
.4 Mechanically attach to all window and door frames.

3.5 FIELD QUALITY CONTROL

.1 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. Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.
.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.7 PROTECTION OF WORK

.1 Protect finished work in accordance with Section 01 61 00 - Common Product Requirements.
.2 Do not permit adjacent work to damage work of this section.
.3 Ensure finished work is protected from climatic conditions.

3.8 SCHEDULES

.1 Window and Door Frame Perimeters:
.1 Adhere sheet to wall air seal surface with 3” (75 mm) of full contact over firm bearing to window or door frame with 1” (25 mm) of full contact.

End Of Section

Part 1 General

1.1 GENERAL INSTRUCTIONS

.1 Read and conform to Division 01 requirements.

1.2 References

.1 Fabricated rain screen designed ACM system components shall meet the following:

.1 AAMA 508-07 Standard. Voluntary test method and specification for pressure equalized rain screen wall cladding systems.

.2 Fabricated rain screen designed ACM system components shall meet the following test methods for Air/Water/Wind Performance:

.1 AAMA 501.1-05 Dynamic
.2 ATM E 1233 Modified
.3 ASTM E 283 Static
.4 ASTM E 330 Static
.5 ASTM E 331 Static

1.3 QUALITY ASSURANCE

.1 Supplier shall design, supply, fabricate and install work of this Section

.2 Supplier | installer shall have minimum 10 years proven fabrication and installation experience and must have completed at least five (5) major aluminum wall panel projects.

.3 All system components shall be provided from a single manufacturer.

1.4 DESIGN AND PREFORMANCE REQUIREMENTS

.1 Design, fabricate and erect wall panel system to meet the following requirements:

.1 Rain penetration: prevent rain penetration through system. Design system based on "Rain Screen Principle" by the National Research Council. Incorporate means of draining to the exterior space between wall panel and water barrier.

.2 Wind Load: Design wall system to resist wind loads, positive and negative, expected in this geographical region (OBC climactic data, 100 year probability) without causing rattling, vibration or excessive deflection of panels, overstressing of fasteners, clips and other detrimental effects on wall system.

.3 Structural and thermal movement: Accommodate movement of supporting structural framing and movement caused by thermal expansion and contraction of system component parts without causing bowing, buckling, delamination, oil canning, failure of joint seals, excessive stress on fasteners or any other detrimental effects.

.4 Air Barrier: Shall be continuous and sealed at joints, laps, terminations and penetrations to prevent air infiltration and exhilaration and to effectively retard moisture vapour migration through system.

.2 Panel flatness tolerance: Fabricate panels not exceeding the following tolerances:

.1 Applying to even rises and falls across panel; local bumps and depressions shall not be accepted:

.1 1.5 mm in a convex direction, measured perpendicularly to normal plane.

.2 1.5 mm in a concave direction, measured perpendicularly to normal plane.

.3 Panel removal: System shall be non-progressive, allowing removal of any individual panel without necessitating removal of adjacent work.

.4 Maximum deviation from vertical and horizontal alignment of erected panels: 6 mm in 6m.

.5 Maximum deviation from panel flatness shall be 1/8" in 5'-0" panel in any direction for assembled units (non-accumulative).

1.5 SUBMITTALS

.1 Samples:

.1 Submit samples in accordance with Section 01 33 00 Submittal Procedures
.2 Submit duplicate, minimum 200 x 200 mm samples of each colour selected.

.2 Shop Drawings:
.1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures
.2 Indicate elevations, profiles, dimensions and thickness of panels.
.3 Indicate location and detail of joints including joints necessary to accommodate thermal movement.
.4 Indicate attachment clips, joint extrusion system and installation details.
.5 Show fastening and anchoring details.

.3 Maintenance Data:
.1 Provide maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual specified in Section 01 77 00 Closeout Procedures and Submittals.
.2 Submit instructions for touch-up, repair and removal of panels.

.4 Maintenance Material:
.1 Submit 1 sealed can of touch up paint, properly identified for each panel colour provided.

1.6 WARRANTY

.1 For work in this Section, warranty against defects or deficiencies in materials or workmanship shall be for a period of three (3) years from date of Substantial Performance.

.2 Provide three (3) copies of a manufacturer's written warranty for inclusion in the Project Manuals:
.1 Furnish panel manufacturer's written warranty covering failure of factory applied exterior finish on composite metal panels within the warranty period; warrant finish per ASTM D4214 for chalk not in excess of 8 NBS units and fade not in excess of 5 NBS units. Warranty period for finish: 10 years from date of Substantial Performance.

1.7 MOCK-UP

.1 Erect mock-up panel approximately 4.0m long x 1.6m high in location as directed by consultant.

.2 Mock-up panel shall include all components of the wall system and if approved by Consultant, may be incorporated into the finished work.

.3 Notify 72 hours before installation of mock-up for inspection by Consultant. Do not proceed with panel system work until mock-up has been inspected and approved in writting.

1.8 PRODUCT DELIVERY, HANDLING AND STORAGE

.1 Protect finish and edges using a plastic film adhered to panel in accordance with panel manufacturer's recommendations.

.2 Store components and materials in accordance with manufacturer's recommendations.

Part 2 Products

2.1 MATERIALS

.1 Composite Panel System Acceptable Products:
.1 Alcotex
.2 or Approved Alternate

.2 Composite Panel System Acceptable Fabricators:
.1 Flynn Canada
.2 Sobotec
.3 Kanalco

.4 Ontario Panalization
.5 Riverside Group
.6 or Approved Alternate

.3 Aluminum Panels
.1 Composition: two sheets of aluminum sandwiching a core of extruded thermoplastic, formed in a continuous process without the use of glues or adhesives between dissimilar materials. Bond integrity testing to adhere to ASTM D1781-76.
.2 Aluminum face sheets: Aluminum alloy 3003, thickness 0.51 mm.
.3 Panel thickness: 4 mm.
.4 Panel weight: 5.28 kg/sq.m
.5 Tolerances:
.1 Panel bow: maximum 0.8% of panel dimension (width or length).
.2 Panel Dimensions: make allowances for field adjustments, in manner recommended by manufacturer, where final dimensions cannot be established by field measurement prior to panel manufacturing.
.3 Panel lines, breaks and angles to be sharp and true; panel surfaces to be free from warp or buckle.
.4 Panel finishes: Aluminum Association Designation System for Aluminum Finishes. Duranar finish to match aluminum curtain wall and windows to Consultant's approval.
.5 Panel and wall accessories:
.1 Provide proprietary aluminum extrusions, compatible with panel edges, to manufacturer's standard profiles, including vertical and horizontal joint closures and perimeter trim as required for a complete installation.
.2 Fasteners: as recommended by the panel manufacturer, concealed and non-corrosive.
.3 Extrusions and extrusion clips for attaching panels to the sub-structure: purpose made aluminum.
.4 Plastic shims shall be used as thermal separators between extrusions and subgirts.
.5 Joint Filler Strip: same material as panels.
.6 Adjustable z-bars, z-bars and Sub-girts: manufactured from G-90 galvanized steel, if required and shall be designed to accommodate expansion and contraction, dynamic movements and design load requirements.

Part 3 Execution

3.1 EXAMINATION

.1 Examine work of other sections upon which this section depends.
.2 Report any unsatisfactory conditions to Consultant in writing. Do not start work until unsatisfactory conditions are rectified.
.3 Commencement of work implies acceptance of conditions.

3.2 SUB-GIRT, Z-BARS AND ADJUSTABLE ANGLES

.1 Erect sub-girts, z-bars and adjustable angles through air/vapour barrier to steel studs and exterior sheathing in accordance with system manufacturers installation details and instructions.

3.3 WALL PANEL SYSTEM INSTALLATION

.1 Erect panels and joint extrusions in accordance with system manufacturer's details and instructions and so as to meet specified design and performance requirements.
.2 Finished work shall be securely anchored, free of distortion and surface imperfections, uniform in colour and gloss.

.3 Use concealed fastenings only, except where exposed fastenings are specifically permitted by Consultant in writing.
.4 Install panels plumb, true, level and in alignment to established lines and elevations.
.5 Where indicated on drawings, or as required to complete work of this section, supply and install closures, caps, fascias, covers and trims with colour matching panel finish, where exposed.
.6 Anchor panels securely in accordance with reviewed shop drawings using concealed, non-corrosive fasteners types and location recommended by the manufacturer. Anchorage system shall allow for necessary thermal movement and structural support.
.7 Caulk between work of this section and work of other sections to provide a watertight installation.

3.4 CLEAN UP

.1 Remove protective film from panels.
.2 Clean exposed panel surfaces in accordance with manufacturer's instructions.
.3 Repair and touch-up with colour matching high grade enamel minor surface damage, only where permitted by Consultant and only where appearance after touch up is acceptable to Owner and Consultant.
.4 Replace damaged panels and components which in opinion of Consultant cannot be satisfactorily repaired.
.5 Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 10 00 Rough Carpentry.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B18.6.3-2011, Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series).

.2 ASTM International
- .1 ASTM D2369-10e1, Test Method for Volatile Content of Coatings.
- .2 ASTM D2832-92(2011), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
- .3 ASTM D5116-10, Standard Guide For Small-Scale Environmental Chambe
- .4 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 Determinations of Organic Emissions From Indoor Materials/Products.
- .6 ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- .7 ASTM D4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films

.3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-93.3-M91, Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use.
- .2 CAN/CGSB-93.4-92, Galvanized and Aluminum-Zinc Alloy Coated Steel Siding Soffits and Fascia, Prefinished, Residential.
- .3 CAN/CGSB-93.5-92, Installation of Metal Residential Siding, Soffits and Fascia.

.4 CSA International
- .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples
- .2 CSA G164 - Hot Dip Galvanizing Of Irregularly Shaped Articles
- .3 CSA S136 - North American Specification For The Design Of Cold-Formed Steel Structural Members.

.5 CSSBI 20M - Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications.

.6 CSSBI 23M - Standard for Residential Steel Cladding

.7 UL 1897 - Uplift Tests for Roof Covering Systems

.8 CAGBC Canadian Green Building Council - Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for [metal siding] and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit 2 copies of WHMIS SDS.

.3 Samples:
- .1 Submit duplicate samples of siding material, of colour and profile specified.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: submit 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, store and handle materials in accordance 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.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect metal siding from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse pallets, crates, padding, packaging materials.

1.6 Coordination:

.1 Coordinate with installers of wall mounted items, equipment, and mechanical and electrical work so that installation shall not compromise the performance and aesthetics of the steel siding.

.2 Coordinate work of Division 07 Sections, openings and penetrations.

1.7 WARRANTY

.1 Special Finish Warranty: Provide a manufacturer's written warranty: Furnish siding manufacturer's written warranty covering failure of factory-applied exterior finish within the warranty period. Period: Forty (40) years from the date of purchase of the Product. The values below are based on normal environments and exclude any aggressive atmospheric conditions.

.2 Weather XL - Silicone Modified Polyester (SMP):

.1 The Product shall not chip, crack, peel or otherwise lose adhesion for a period of forty (40) years following the original date of purchase of the Product.

.2 The colour shall not chalk in excess of number eight (8) rating as determined by ASTM D4214 Method D659, and the colour shall not change more than five (5.0) Hunter ΔE units as determined by ASTM Method D-2244 for a period of thirty (30) years from installation or thirty and half (30.5) years from the date of purchase.

.3 Expressence (print) - Fluoropon (PVDF):

.1 This Product shall not exhibit cracking, chipping or peeling (loss of adhesion) to an extent that is apparent on ordinary outdoor visual observation for a period of forty (40) years from the date of installation of the panels.

.2 Chalk - ASTM 4214 - #8 for thirty (30) years of exposure.
Colour change: The print appearance shall remain intact during the first twenty (20) years of exposure. Colour change shall be uniform

.3 Minute fracturing, which may occur in proper fabrication of the building parts, is not a covered Warranty Condition. Failure due to substrate corrosion is not a covered Warranty Condition.

.4 The print coat shall remain intact and distinguishable for a period of twenty (20) years from the date of installation of the panels.

Part 2 Products

2.1 Steel Siding

.1 Prefinished steel siding, concealed fastener system for exterior application and as follows:

.1 Metal sheet: Zinc coated (galvanized) sheet steel to the requirements of ASTM A653/A653M with a minimum metallic coating designation Z275 (G90).

.2 Preformed metal thickness: 0.46 mm (26 gauge) base steel nominal thickness.

.3 Exposed preformed steel profile

.4 Acceptable Products:
.1 As per Material Finish Legend.
.2 Or approved Alternate

.2 Z Girt Purlin Attachment system: siding manufacturer's standard Z girts, of lengths and sizes indicated on drawings and as required to complete installation.

2.2 Finish

.1 PVDF Coating Finish: Colour as selected by Owner from manufacturer's standard range.

2.3 CAULKING

.1 Sealants: in accordance with Section 07 90 00 - Joint Sealants.

2.4 ACCESSORIES

.1 Prefinished aluminum Exposed trim: inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material, colour gloss as cladding, with fastener holes pre-punched. Provide siding manufacturer's accessories and starter strips as required to complete installation

.2 Non-exposed accessories: as recommended by siding manufacturer.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.

3.2 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.

3.3 INSTALLATION

.1 Install cladding in accordance with CGSB 93.5, and manufacturer's written instructions.
.2 Install Z Girt purlins as indicated on drawings.
.3 Install continuous starter strips, inside and outside corners, edgings, soffit, drip, cap, sill and window/door opening flashings as indicated.
.4 Install outside corners, fillers and closure strips with carefully formed and profiled work.
.5 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.
.6 Attach components in manner not restricting thermal movement.
.7 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 90 00 - Joint Sealants.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.
.2 Final Cleaning: upon completion of this section remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
.3 Waste Management: separate waste materials for reuse or recycling.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.
.2 Repair damage to adjacent materials caused by preformed metal siding installation.

End Of Section

Part 1 General

1.1 RELATED WORK

1. Section 07 62 00: Metal Flashing and Roof Accessories

1.2 DESCRIPTION OF WORK

1. Furnish and install a mechanically fastened Mechanically Attached TPO Roofing System and related roofing accessories in strict accordance with specifications and details approved by Roof System Manufacturer. Insulation is to be mechanically fastened over a vapour retarder to the roof deck according to Roof System Manufacturer's requirements. TPO membrane sheets are to be mechanically fastened to the roof deck with Roof System Manufacturer's Standard membrane fasteners and heat welded together.

.2 Entire system to be by one manufacturer. Acceptable Products:

- .1 Lexcan Hi Tuff Roof System (Design E)
- .2 Sure-Weld Mechanically Attached Roofing System by Carlisle
- .3 UltraPly TPO MA Roof System by Firestone
- .4 or approved alternate.

1.3 QUALITY ASSURANCE

.1 General Contractor shall restrict access to the roof by all other trades during and after the roofing system construction. General Contractor shall ensure that other trade personnel permitted access to the roof take proper care to prevent damage to work done under this section.

.2 Roofing contractor shall be an approved applicator of roofing system as determined by Roof System Manufacturer.

.3 Workmen shall be trained and experienced in the installation of this type of roofing system and shall be under full time competent supervision.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver all roofing materials in original, unopened containers, complete with labels indicating brand name, contents, usage instructions and safety precautions. Membrane rolls are to be left in their unopened packaging until immediately prior to use.

.2 Protect membranes from cuts, abrasion or other abuse that might adversely affect performance in service.

.3 WHIMS safety bulletins on all hazardous products are to be readily available to the work crew at all times.

.4 Adhesives, sealants and flashing accessories are to be stored in a clean, dry area at a temperature between 5°C and 27°C. If exposed to a lower temperature, restore to an acceptable level before using.

.5 Do not work during periods of rain, fog, sleet, snow or cold temperatures (below - 15°C).

.6 Ensure insulation and membrane fasteners shall not damage or penetrate under deck wires, conduits, pipes etc.

1.5 WARRANTY

.1 Roofing System supplier shall provide a written watertight warranty on supplier's standard form for a period of 15 years from the date of roofing system completion.

.2 Roofing Contractor shall provide a written warranty against leaks or workmanship defects for a period of two years from the date of roofing system completion.

Part 2 Products

2.1 VAPOUR RETARDER, INSULATION & INSULATION SECUREMENT:

.1 Vapour Retarder: Minimum 10 mil thick polyethylene vapour retarder meeting CGSB 51-34-M86 and with a moisture vapour transmission rate less than 2.4 ng/Pa•s• m^2 (0.04 perms) when tested in accordance with ASTM E-96, procedure B.

.2 Polyisocyanurate Roof Insulation: Thickness to achieve R values indicated, thick black glass/felt faced polyisocyanurate foam insulation meeting the requirements of CAN/ULC-S704 and having a minimum compressive strength of 140 kPa (20 psi). Apply in two layers.

Accepted Product: Isolex Isocyanurate Insulation or approved alternate.

.3 Tapered Insulation: Polyisocyanurate foam insulation faced with black glass/felt facers on one side and meeting the requirements of CAN/ULC-S704. Insulation panels are to measure 1220 mm (4') square and are to slope at the rate indicated on drawings, with a minimum thickness of 12 mm (0.5") at the drains. Panels are to be positioned and installed in accordance with the shop drawings.

2.2 ROOF MEMBRANE SYSTEM

.1 Membrane: White, 1.5 mm thick polyester scrim reinforced TPO membrane meeting the physical characteristics shown in table 1.

Table 1: TPO Membrane Specifications

PROPERTY .045" THICK	A.S.T.M. TEST METHOD	PROPERTY BEFORE AGING	PROPERTY AFTER AGING
Thickness Tolerance	ASTM D-751	± 10%	± 10%
Thickness over Scrim	ASTM D-4637 Optical	0.381 mm (0.015")	
Elongation at Fabric Break	ASTM D-751	25% typical	25% typical
Breaking Strength	ASTM D-751, Mtd A	1.0 kN (225 lbf) min. 1.5 kN (340 lbf) typical	1.0 kN (225 lbf) min. 1.5 kN (340 lbf) typical
Tearing Strength	ASTM D-751, (B Tongue Tear)	245 N (55 lbf) min. 578 N (130 lbf) typical	245 N (55 lbf) min. 578 N (130 lbf) typ.
Puncture Resistance	FTM 101 C, Mtd. 2031 1.1 mm (0.045") Thick: 1.5 mm (0.060") Thick:	1.11 kN (250 lbf) min. 1.33 kN (300 lbf) typ. 1.56 kN (350 lbf) typ.	1.11 kN (250 lbf) min 1.33 kN (300 lbf) typ. 1.56 kN (350 lbf) typ.
Linear Dimensional Change	ASTM D-1204		± 1 % max. -0.5% typical
Brittleness Point	ASTM D-2137	- 40°C min. - 46°C typical	
Ozone Resistance	ASTM D-1149 (168 hrs @ 100pphm)	No Cracks	No Cracks
Water Absorption	ASTM D-471 (7 days @ 70°C)		+ 4.0% max. + 2.0% typical
Water Vapour Permeance	ASTM E-96 (7 days @ 70°C)	0.10 Perms max. 0.05 Perms typical	
Accelerated Weathering 5040kJ / m^2 Xenon-Arc 10 X Magnification	ASTM G-26 (0.70 W / m^2) (80EC B.P.T.)		No Cracks No loss of breaking or tearing strength
Solar Reflectance, % 65% req'd for Energy Star™ typ.	albedo x 100	White: 75 min., 87 typical Spectrum Reflectometer Tan: 65 min., 70	
Resistance to Microbial Growth	ASTM D-2374 S. Florida, 2 yrs.		9 - 10 typical

.2 Perimeter Sheets and Parapet/Wall Flashing: TPO membrane sheets, meeting Roof System Manufacturer's width requirements.

.3 Corner & Protrusion Flashing: Roof System Manufacturer's standard TPO non-reinforced Flashing.
.4 Membrane Cleaner: Roof System Manufacturer's Standard,.
.5 Cut Membrane Edge Sealant: Roof System Manufacturer's Standard.
.6 Membrane Fasteners Metal Decks: Roof system manufacturer's standard Membrane Fasteners (pre-assembled or loose), treated with corrosion resistant coating and complete with 60 mm (2-3/8") diameter barbed Lap Plate. Fastener must be of sufficient length to penetrate plate, membrane, insulation, vapour retarder, existing roof and structural steel deck a minimum of 13 mm (0.5").
.7 Bonding Adhesives: Roof System Manufacturer's Standard.
.8 Water Cut-Off Mastic: Roof System Manufacturer's Standard
.9 Sealers, Mastics and Tapes: Roof System Manufacturer's Standard:
.10 Traffic Pads as per manufacture's standard.

2.3 ACCESSORIES

.1 As per Section 07 62 00 Metal Flashings & Roof Accessories.

Part 3 Execution

3.1 GENERAL

.1 Only install as much vapour retarder and insulation as can be completely and properly covered by the roofing membrane by the end of each work period.
.2 Comply with roof system manufacturer's current published installation instructions and details throughout the roofing membrane installation.
.3 There shall be no smoking by any personnel while on the roof. Protect the roof membrane at all times from high heat sources such as cigarette butts or sparks from nearby welding.

3.2 INSPECTION

.1 Examine roof deck to verify proper placement of all roof openings, pipes, curbs, sleeves, ducts, vents and drains. Ensure all wood blocking is installed where required. Ensure roof deck is clean, dry and free from debris that might be detrimental to the performance of the vapour retarder, insulation or membrane.

3.3 VAPOUR RETARDER & NAILER INSTALLATION

.1 Install vapour retarder membrane according to the vapour retarder supplier's installation instructions. Ensure vapour retarder membrane is completely sealed to all roof protrusions and around the perimeter.
.2 At perimeters and curbs, vapour retarder is to extend up and around edge of insulation and a minimum of 75 mm (3") out over top of the insulation.
.3 Fasten nailers where shown on the shop drawings. Wood nailers shall be fastened to resist a minimum force of 300 kg/m in any direction.

3.4 POSITIONING & FASTENING MEMBRANE SHEETS

.1 The contractor shall be responsible for the suitability of the substrate surface to accept the membrane. Ensure insulation surface or substrate is clean, flat and free from dirt, debris or sharp objects that might be detrimental to the performance of the membrane.
.2 Membrane sheets shall be installed in accordance with Roof System Manufacturer's Standard requirements, shown in Table 3 below. Fasten perimeter sheets in a picture frame pattern around the perimeter. Install field sheets perpendicular to the underlying insulation's greater dimension.

TABLE 3: Membrane Fastening Requirements:

Building Height		Maximum Field Sheet Width	Maximum Perimeter Sheet Width	No. of Perimeter Sheets
Less than 21 m	Less than 70'	12'	6'	2

.3 Unroll membrane sheets and position according to the approved shop drawings. Outside perimeter sheets shall be brought flush to the base of the perimeter parapet or wall†, or in the case of a roof edge, extend over the outside edge a minimum of 75 mm (3"). Adjoining sheets are to overlap a minimum of 140 mm (5.5") on sides and wherever fasteners are included within the seam. End laps without fasteners are to be lapped a minimum of 6 cm (2").

.4 Roof System Manufacturer's Standard Membrane Fasteners for the type of deck are to be fastened 50 mm (2") in from the side edge of both perimeter and field membrane sheets, [on maximum 305 mm (12") centres. Fastener plates and heads shall be flush with the membrane and shall penetrate the membrane, insulation and structural deck according to the specific requirements of the type of fastener. Do not overdrive fasteners to the point where the membrane plate is deformed.

.5 Each membrane sheet shall be completely fastened before proceeding to the next sheet.

3.5 SPLICING MEMBRANE SHEETS

.1 Field seams must be welded with an automatic hot air welder operated by an individual thoroughly trained and competent in the machine's operation. Small work and repairs can be done efficiently with a hand welder, however, hand-held welders are not an accepted means of field seaming.

.2 Hot air weld all seams a minimum of 38 mm (1.5") wide.

.3 Dirty, dusty or contaminated membrane or membrane exposed for more than seven days prior to welding must be cleaned with TPO Weathered Membrane Cleaner. With a clean scrub pad saturated with TPO Weathered Membrane Cleaner, aggressively scrub the seam area of the roof membrane. Follow with a final one swipe pass, being careful not to re-deposit contaminants back onto the cleaned area. Ensure that the Cleaner and adjacent Bonding Adhesive has completely flashed off before welding. Follow standard welding procedures with a 20% reduction in speed.

.4 All splices are to be probed along their entire length with a seam probing tool to verify that the welder is operating effectively. The membrane must be allowed to cool prior to testing. In addition, there should be a destructive peel strength test performed at the start of each day and each time the robot welder is reused after being allowed to cool. The destructive test sample should be 5 cm (2") wide and should show membrane delamination from the scrim prior to weld failure.

.5 Cut membrane edges shall be sealed by applying TPO Cut Edge Sealant along the exposed edge.

3.6 PERIMETER FLASHING & SECUREMENT

.1 Roof membrane shall be brought flush to parapets, walls, expansion joints, curbs and all other roof penetrations that exceed 60 cm (24") in any dimension and be mechanically fastened parallel to the perimeter through the insulation, vapour retarder to the structural deck on 30 cm (12") centres with Roof System Manufacturer's Standard Membrane Fasteners and Plates. The perimeter fastener row shall be centred no further than 150 mm (6") from the perimeter.

.2 Reinforced Membrane flashing membrane shall be extended up all parapet walls, curbs, roof edges.

.3 Adhere flashing membrane to all vertical walls and parapets using Roof System Manufacturer's Standard Bonding Adhesive applied to Manufacturer's instructions. Do not apply the Bonding Adhesive to areas on the membrane that are to be heat welded. Apply adhesive evenly, without globs or puddles. Allow the adhesive to flash-off until it is tacky but does not string when touched with a dry finger. Roll the membrane onto the substrate, being careful not to wrinkle the membrane or bridge it at the vertical / horizontal juncture (crease the membrane first). Brush the membrane heavily with a push broom to assure complete contact over all bonded areas.

.4 Terminate Membrane in a reglet, or carry over top of wall or parapet and counter-flash with sheet metal All metal work must be installed to be wind resistant and sealed and waterproofed in an acceptable manner.

3.7 PROTRUSION & CORNER FLASHINGS

.1 Install pre-formed metal flashings, drain hoppers etc. according to the manufacturer's installation instructions.

.2 Flash all corners, vent pipes, posts, curbs and pre-formed flashings in strict accordance with current Roof System Manufacturer's Standard installation instructions and details. Use Roof System Manufacturer's Standard adhesives and sealants, installed in accordance with Roof System Manufacturer's Standard installation requirements and details. Do not apply adhesives to areas on the Flashing that are to be seamed.

.3 All flashing shall be mechanically fastened at the top, under or through appropriate counterflashing with approved fasteners and in accordance with Roof System Manufacturer's Standard details.

.4 Membrane connections to drains are to be sealed with Roof System Manufacturer's Standard sealers and clamped with a clamping ring to assure a 100% continuous seal. Field seams shall not run through drains.

3.8 TEMPORARY NIGHT SEAL

.1 At the end of each day or at the threat or onset of inclement weather, the insulation shall be protected by extending the membrane beyond the insulation and sealing it to the deck with Roof System Manufacturer's Standard temporary sealant. Ensure membrane edge is either mechanically fastened or sufficiently ballasted to protect against wind uplift.

.2 When resuming work, cut and dispose of portion of membrane contaminated with the night sealant.

3.9 FIELD QUALITY CONTROL

.1 Field inspection and testing shall be performed as required by the manufacturer.

.1 Correct identified defects or irregularities. Remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial completion and according to warranty requirements.

.2 Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect. Notify Consultant 48 hours in advance of the date and time of inspection.

3.10 CLEAN-UP

.1 Clean all contaminants from building and surrounding areas.

.2 Remove trash, debris and equipment from project site and surrounding areas.

.3 Repair or replace damaged building components or surrounding areas to the satisfaction of the Consultant.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 54 00 Mechanically Attached TPO Roofing

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.2 Canadian Roofing Contractors Association (CRCA)
  .1 Roofing Specifications Manual.
.3 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.
.4 Canadian Standards Association (CSA International)
  .1 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.
  .2 CSA B111-1974(R2003) Wire Nails, Spikes and Staples.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit two copies WHMIS SDS - Safety Data Sheets.
.3 Samples:
  .1 Submit 2” x 2” samples of each type of sheet metal material, finishes and colours.
.4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
.2 Waste Management and Disposal:
  .1 Separate waste materials for reuse or recycling.

Part 2 Products

2.1 SHEET METAL MATERIALS AND OTHER ACCESSORIES

.1 Prepainted Galvanized Steel: commercial quality to ASTM A653-M96 with Z275 zinc coating prepainted with baked on enamel with colours of proven durability for exterior exposure, to CSSBI Technical Bulletin No. 7, 5000 series. Colours as selected by Owner. Thickness as follows:
  .1 Sheet Metal Flashing: 24 ga.
  .2 Miscellaneous metal for "hook-on" strips, fastening strips, metal bellows etc.: 1 ga. thicker than sheet metal flashing.
.2 Flashing Nails: #12 hot dipped zinc coated, annular ringed.
.3 Sheet Metal Screws: Cadmium plated, self tapping, pan head.
.4 Bituminous Paint: solvent type, to CAN/CGSB-1.108-M89, type II.
.5 Plastic Cement: cutback asphalt type, to CAN/CGSB-37.5-M89.
.6 Sealant: one component, elastomeric, chemical curing, CAN/CGSB-19.13-M87.
.7 Flashing Anchor Clips: 0.80 mm thick galvanized steel.

2.2 NAILERS FOR FLANGES AND ROOF ACCESSORIES

.1 Wood: to NLGA Standard Grading Rules for Canadian Lumber, February 1, 1996 including Supplement No. 1 November 25, 1996 and Supplement No. 2 May 1, 1997, 121c. "Standard" Light Framing; spruce, pine or fir (SPF). All wood shall be pressure

treated for rot resistance unless nailer is in direct contact with membrane adhesives in final assembly.

.2 Nailer width: Minimum 3 ½ in. (nominal) wide or as wide as the nailing flange of each roof accessory.

.3 Nailer thickness: Thickness of roof insulation.

.4 Exterior Grade Plywood: Douglas Fir to CSA 0121-M1978, standard construction, good one side. Refer to drawings for thickness required.

.5 Fasteners:

.1 Nails, spikes and staples: to CSA B111-1974.

.2 Bolts: 15.9 mm diameter unless indicated otherwise, complete with nuts and washers. Space anchor bolts in stud walls 1t 1200 mm (4'-0") o.c. maximum

.3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

.4 Galvanizing: to CSA G164-M1981, use galvanized fasteners for exterior work.

2.3 ROOF ACCESSORIES

.1 Vandal proof Vent Stacks and Caps: vandal-proof vent stacks and caps to be Thaler Metal Industries Ltd. Model No. SJ-26 (aluminum) PVC with stainless steel SJ-33 caps or approved alternate.

.2 Roof Drains: Supplied by Division 22, Installed by this Section

.3 HDG threaded rods, nuts, and washers OR approved alternate.

.4 Isolation coating: alkali resistant bituminous paint.

.5 Plastic cement: to CAN/CGSB 37.5.

.6 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.

.7 Sealants: in accordance with Section 07 90 00.

.8 Portable Pipe Hangers: As specified in Division 20, installed by this division

.9 Roof Penetrations: As specified in Division 20, installed by this division

2.4 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details and as indicated.

.2 Form pieces in 8'-0" (2400 mm) maximum lengths.

.1 Make allowance for expansion at joints.

.2 Hem exposed edges on underside ½" (12 mm).

.3 Mitre and seal corners with sealant.

.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

.1 Form flashings, copings and fascias to profiles indicated of 26 ga. thick prefinished aluminum.

2.6 CAP FLASHINGS

.1 Form metal cap flashing of 26 ga thick prefinished aluminum sheet metal

.1 Provide slotted fixing holes and steel/plastic washer fasteners.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install sheet metal work in accordance with CRCA FL series details, and as detailed.

.2 Use concealed fastenings except where approved before installation.

.3 Provide underlay under sheet metal.
.1 Secure in place and lap joints 4” (100 mm).
.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
.1 Flash joints using S-lock forming tight fit over hook strips, as detailed.
.5 Lock end joints and caulk with sealant.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.
.2 On completion of this section and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
.3 Leave work areas clean, free from grease, finger marks and stains.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 54 00 Mechanically Attached TPO Roofing

1.2 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.

1.3 QUALITY ASSURANCE

.1 General Requirements:
- .1 Equipment provided shall incorporate the manufacturers latest design improvements and materials in place as of date of manufacture.

.2 Manufacturer:
- .1 Shall be an established firm experienced no less than 5 years experience with similar installations.

.3 Installer:
- .1 Installation shall be performed by manufacturer's authorized installer.

1.4 Product Delivery, Storage and Handling

.1 Deliver materials of this section to suit construction schedules; ensure related trades have completed their work

.2 Materials shall be stored in a secure location provided by the General Contractor

.3 Deliver products' in manufacturer's original packaging. Inspect product upon receipt and report damaged materials immediately.

1.5 Site Conditions

.1 Ensure the area is neat and clean and that there are no obstructions which may affect the safety of the installers.

.2 Ensure all related trades which affect the work of this section have completed their work.

1.6 Warranty

Provide a written warranty covering defects in materials and workmanship for a period of Five (5) years from the date of installation.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Remove from site packaging materials at appropriate recycling facilities.

.3 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 Products

2.1 ROOF HATCH

.1 Furnish and install where indicated on plans metal roof hatch size width: 36" x 30". Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.
- .1 Acceptable Manufacturer’s:
  - .1 Bilco Type S20
  - .2 Lexcor R-100
  - .3 Or approved Alternates

.2 Performance characteristics:

1. Cover and curb shall be thermally broken to prevent heat transfer between interior and exterior surfaces.
2. Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m^2) with a maximum deflection of 1/150th of the span or 20 psf (97kg/m^2) wind uplift.
3. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
4. Operation of the cover shall not be affected by temperature.
5. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.

.3 Cover

.1 Shall be 11 gauge aluminum with a 5" beaded flange with formed reinforcing members. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. Cover shall have a heavy extruded EPDM rubber gasket bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

.4 Cover insulation: Shall be 3" thick polyisocyanurate with an R-value = 18 , fully covered and protected by an 18 gauge (1mm) aluminum liner.

.5 Curb

.1 Shall be 12" (305mm) in height and of 11 gauge (2.3mm) aluminum. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. The curb shall be formed with a 5-1/2" (140mm) flange with 7/16" (11mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.

.6 Curb insulation:

.1 Shall be 3" (75mm) thick polyisocyanurate with an R-value = 18

.7 Lifting mechanisms:

.1 Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.

.8 Hardware

.1 Heavy stainless steel pintle hinges shall be provided

.2 Cover shall be equipped with a spring latch with interior and exterior turn handles

.3 Roof hatch shall be equipped with interior and exterior padlock hasps.

.4 The latch strike shall be a stamped component bolted to the curb assembly.

.5 Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.

.6 Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. [For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware].

.7 Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

.9 Finishes: Factory finish shall be mill finish aluminum.

Part 3 Execution

3.1 EXAMINANTION

.1 Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

1.2 INSTALLATION

.1 Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.

1. Test units for proper function and adjust until proper operation is achieved.
2. Repair finishes damaged during installation.
3. Restore finishes so no evidence remains of corrective work.

1.3 ADJUSTING AND CLEANING

.1 Clean exposed surfaces using methods acceptable to the manufacturer which shall not damage finish.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Masonry: Section 04 00 00
.2 Joint Sealing: Section 07 90 00
.3 Gypsum Board Assemblies: Section 09 21 16

1.2 REFERENCES

.1 ASTM E814, Test Method for Fire Tests of Through-Penetration Fire Stops
.2 CAN/CGSB 19.13, Sealing Compound, One Component, Elastomeric, Chemical Curing.
.3 CAN\ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.
.4 Can\ULC S115, Standard Method of Fire tests of Firestop Systems.
.5 CAN\ULC S702, Thermal Insulation, Mineral Fibre for Buildings

1.3 DEFINITIONS

.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
.4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
    .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.4 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 datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
    .2 Submit two (2) copies of WHMIS SDS - Safety Data Sheets.
.3 Shop Drawings:
    .1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.
    .2 Construction details should accurately reflect actual job conditions.
.4 Samples:
    .1 Submit samples showing actual firestopping material and smoke seal material as requested.
.5 Manufacturer's Instructions:
    .1 Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and certificates.

1.5 QUALITY ASSURANCE

.1 Manufacturer's Qualifications: Company specializing in manufacturing products of this Section with minimum Five (5) years experience in quality management systems.
.2 Installer's Qualifications: Provide work of the Section executed by competent installers experienced, trained and approved by the material or system manufacturer for the application of materials and systems being used have a minimum of three (3) years experience.

.3 Single Source Responsibility: Ensure primary material are obtained from 1 source by a single manufacture and secondary materials are obtained from source recommended by primary material manufacturer.

1.6 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 manufacturer and ULC markings.

.2 Storage and Protection:
- .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Replace defective or damaged materials with new.

1.7 PROJECT CONDITIONS

.1 Comply with Manufacturer's recommended requirements for temperature, relative humidity and substrate conditions during application and curing of materials.

1.8 SCHEDULING

.1 Co-ordinate installation of work of this Section with work of other trades to ensure firestopping and smoke sealing applications can be inspected prior to being covered by subsequent construction.

Part 2 Products

2.1 MATERIALS

.1 Fire Stopping and smoke seal systems: in accordance with CAN-ULC-S115.
- .1 Asbestos-free material and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended.
- .2 Fire Stop Rating: Equal to assembly rating material or system is located.

.2 Service Penetrations assemblies: systems tested to CAN-ULC-S115.

.3 Service Penetration fire stop component: certified by test laboratory to CAN-ULC-S115.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.7 Primers: to manufacturer's recommendation for specific material, substrate and end use.

.8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.9 Damming and buck up materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities have jurisdiction.

.10 Sealants for Vertical Joints: non-sagging.

2.2 ACCEPTABLE MATERIALS

.1 Products of the following manufacturers are acceptable subject to conformance of the requirements of the Drawings, Schedules and Specifications:
- .1 3M Fire Protection Products
- .2 Ad Fire Protection Systems Inc
- .3 Hilti Canada Corporation
- .4 Tremco (Canada) Ltd

.5 Dow Corning Corporation
.6 Or approved alternate

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTION

.1 Compliance: comply with manufacturer's written specifications or recommendations, including product technical bulletins, handling, storage and installation instructions.

3.2 EXAMINATION

.1 Verify substrate and surfaces are under which firestop is to be installed. Notify consultant in writing of any conditions not acceptable for installation. Installation of firestop implies acceptance of installed substrate.

3.3 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of material
  .1 Ensure that substrates and surfaces are clean, dry and frost free.
  .2 Do not apply fire stop material to surfaces previously panted or treated with sealers, curing compounds, water repellants or other coatings unless test have been preformed to ensure compatibility of materials. Remove coatings as required.
.2 Prepare & prime surfaces in accordance with manufacturer's written instructions.
.3 Maintain insulation around pipes and ducts penetrating fire separations without interruption to vapour barrier.
.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.
.5 Ensure that anchorage devices, clips, sleeves, supports, back-up materials and other related materials have been approved in the actual fire tests provided.

3.4 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing for type of material and condition of openings in each case.
.2 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.
.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.
.5 Remove excess compound and fire stopping material promptly as work progresses and upon completion of this section.
.6 Provide leak-proof dams as required to seal opening and contain firestop until cured.

3.5 SEQUENCE OF OPERATION

.1 Proceed with installation only when submittals have been reviewed in writing by Consultant.
.2 Install floor fire stopping before interior partition erections.
.3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
.5 Ensure pipe insulation installation precedes fire stopping.

3.6 FIELD QUALITY CONTROL

.1 Inspections: notify Consultant at least 48 hours before. when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

.2 Schedule site visits, to review work, as per Part 1 of this section.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 Cleaning

.2 On completion and verification of performance of installation, remove surplus material, excess materials, rubbish, tool and equipment.

.3 Remove temporary dams after initial set of fire stopping and smoke seal material.

3.8 SCHEDULE

.1 Fire stop and smoke seal at:

- .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
- .2 Edge of floor slabs at curtain wall and precast concrete panels.
- .3 Top of fire-resistance rated masonry and gypsum board partitions.
- .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
- .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
- .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
- .7 Openings and sleeves installed for future use through fire separations.
- .8 Around mechanical and electrical assemblies penetrating fire separations.
- .9 Rigid ducts: greater than 129 cm^2: 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.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials, preparation and application for caulking and sealants.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
- .1 ASTM C919, Standard Practice for Use of Sealants in Acoustical Applications.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-19.13, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

1.3 SUBMITTALS

.1 Submit manufacturer's literature in accordance with Section 01 33 00 Submittal Procedures to describe.
- .1 Caulking compound.
- .2 Primers.
- .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .4 Installation instructions, surface preparation and product limitations.

.2 Submit duplicate samples of each type of material and colour.

.3 Cured samples of exposed sealants for each color where required to match adjacent material.

.4 Manufacturers' instructions to include installation instructions for each product used.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

1.5 PROJECT CONDITIONS

.1 Environmental Limitations:
- .1 Do not proceed with installation of joint sealants under following conditions:
- .2 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4˚C.
- .3 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.

Part 2 Products

2.1 SEALANT MATERIALS - GENERAL

.1 Sealants and Caulking compounds must:
- .1 Meet or exceed all applicable governmental and industrial safety and performance standards; and
- .2 Be manufactured and transported in such a manner that all steps of the process, including the disposal of waste products arising therefrom, shall meet the requirements of all applicable governmental acts, by laws and regulations

including, for facilities located in Canada, the Fisheries Act and the Canadian Environmental Protection Act (CEPA).

.3 Sealant and caulking compounds must not be formulated or manufactured with: aromatic solvents, fibrous talc or asbestos, formaldehyde, halogenated solvents, mecury, lead, cadium, hexavalent chromium, barium or their compounds, except barium sulphate.

.4 Sealant and caulking compounds must no contain a total of volatile organic compound (VOC's) in excess of 5% by height as calculated from records of the amounts of constituents used to make the product.

.5 Sealant and caulking compounds must be accompanied by detailed instructions for proper application so as to minimize health concerns and maximize performance, and information describing proper disposal methods.

.6 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.7 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.

.8 Where sealants are qualified with primers use only these primers.

.9 Sealants acceptable for use on this project must be listed on CGSB Qualified Products List issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIALS

.1 Sealant Type 1: Multi-component, polyepoxide urethane sealant. To meet specified requirements of CAN/CGSB-19.24-M90, Type 2, Class B. DYmeric by Tremco Ltd, or approved alternate.

.2 Sealant Type 2: Mildew resistant, one component neutral cure silicone sealant meeting the specified requirements of CAN/CGSB-19GP22M. Tremsil 600 White by Tremco Ltd., Dow Corning 786 by Dow Corning Corporation, Silicone Sanitary Sealant by GE Canada or approved alternate.

.3 Sealant Type 3: One component, non-skinning, non-hardening acoustical sealant meeting the specified requirements of CAN/CGSB-19.21-M87. Acoustical Sealant by Tremco Ltd or approved alternate.

.4 Sealant Type 4: One component, paintable acrylic latex sealant meeting the specified requirements of specification CGSB-19-GP-17M. Tremflex 834 by Tremco Ltd. or approved alternate.

.5 Sealant Type 5: Multi-component or single component self leveling or slope grade polyurethane sealant. Meeting the specified requirements of ASTM C920, Type M, Grade P, Class 25, Use T, M, A and O. THC 900 or THC 901 hybrid. Vulkem 245 or Vulkem 45 polyurethane by Tremco Ltd, or approved alternate.

.6 Primer: as recommended by Sealant Manufacturer.

.7 Preformed Compressible and Non-Compressible back-up materials.

.1 Polyethylene, Urethane, Neoprene or Vinyl Foam.

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50 %.

.2 Neoprene or Butyl Rubber.

.1 Round solid rod, Shore A hardness 70.

.3 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^3 density, or neoprene foam backer, size as recommended by manufacturer.

.4 Bond Breaker Tape.

.1 Polyethylene bond breaker tape which shall not bond to sealant.

2.3 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.2 Primer: as recommended by manufacturer.

Part 3 Execution

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 SEALANT APPLICATION

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion of this section.

.9 Curing.

- .1 Cure sealants in accordance with sealant manufacturer's instructions.
- .2 Do not cover up sealants until proper curing has taken place.

.10 Cleanup.

- .1 Clean adjacent surfaces immediately and leave Work neat and clean.
- .2 Remove excess and droppings, using recommended cleaners as work progresses.
- .3 Remove masking tape after initial set of sealant.

3.1 SEALANT SCHEDULE

.1 Seal all interior and exterior joints including joints indicated on Drawings and not specified herein, with Sealant Type 1; unless indicated otherwise with another Sealant Type.

.2 Sealant Type 1, shall be used in the following locations:

.1 Perimeter joints of exterior hollow metal door and screen frames and louvre frames.

.2 Exposed control joints in masonry walls.

.3 Caulking in conjunction with flashing and sheet metal.

.4 Caulking and sealing full length of all exterior thresholds. All exterior doors shall have thresholds.

.5 Interior and exterior perimeter caulking and internal window frame caulking of metal windows.

.3 Sealant Type 2 shall be used in the following locations:

.1 Perimeter of plumbing fixtures (eg sinks, urinals, waterclosets, basins, vanities)

.4 Sealant Type 3 shall be used in the following locations:

.1 Joints in conjunction with Metal Studs.

.5 Sealant Type 4 shall be used in the following locations:

.1 All joints between interior hollow metal frames and surrounding material at all locations.

.2 Joints in conjunction with Gypsum Wall Board.

.6 Sealant Type 5 shall be used in the following locations:

.1 Control joints and expansion joints in ceramic and porcelain tile (quarry tile) floors. Apply sealant full depth of tile up to 1/2" deep. If tile is installed over concrete slab, provide bond breaker tape beneath sealant.

End Of Section

Part 1 General

1.1 RELATED SECTIONS

.1 Section 06 10 00 Rough Carpentry
.2 Section 07 21 16 Blanket Insulation.
.3 Section 07 27 00 Air Barrier Transition Strip
.4 Section 07 90 00 Joint Sealing
.5 Section 08 11 16 Aluminum Window Framing
.6 Section 08 44 13 Glazed Aluminum Curtain Wall
.7 Section 08 80 50 Glazing
.8 Finish Hardware: Section 08 71 00

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
  .1 ASTM A653/A653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  .2 ASTM B29-03, Standard Specification for Refined Lead.
  .3 ASTM B749-03, Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
.2 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
  .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
.3 Canadian Standards Association (CSA International)
  .1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
.4 Canadian Steel Door Manufacturers' Association (CSDMA)
  .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
  .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.
.5 Underwriters' Laboratories of Canada (ULC)
  .1 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
  .2 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.
  .3 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:
  .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
  .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
  .3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 for ratings specified or indicated.
  .4 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, ASTM E152 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

1.4 SUBMITTALS

.1 Provide submittals and product data in accordance with Section 01 33 00 - Submittal Procedures.
.2 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, arrangement of hardware and fire rating and finishes.
.2 Indicate each type frame material, core thickness, reinforcements, location of anchors and exposed fastenings and reinforcing finishes.
.3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
.4 Submit test and engineering data, and installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
.2 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 MATERIALS

.1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
.2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.

2.2 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
.2 Polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.3 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

2.4 PAINT

.1 Field paint steel doors and frames in accordance with Section 09 90 00 Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.
.1 Colour to be selected at a later date by Owner.

2.5 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.
.2 Exterior top caps: steel.
.3 Metallic paste filler: to manufacturer's standard.
.4 Fire labels: metal riveted.
.5 Sealant: in accordance with Section 07 90 00 Joint Sealing

2.6 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.
.2 Fabricate frames to profiles and maximum face sizes as indicated.
.3 Exterior frames: 16 ga (1.2 mm) welded type construction.
.4 Interior frames: 16 (1.6 mm) welded or slip-on type construction. Refer to drawings for locations.
.5 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
.6 Protect mortised cutouts with steel guard boxes.
.7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
.8 Manufacturer's nameplates on frames and screens are not permitted.
.9 Conceal fastenings except where exposed fastenings are indicated.

.10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
.11 Insulate exterior frame components with polyurethane insulation.

2.7 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.
.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
.4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.8 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.
.2 Exterior doors: Polyurethane Core. Interior doors: honeycomb construction.
.3 Fabricate doors with longitudinal edges locked seam. Seams: visible.
.4 Blank, reinforce, drill doors and tap for mortised, template hardware.
.5 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
.6 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
.7 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
.8 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN4-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.
.9 Manufacturer's nameplates on doors are not permitted.

2.9 DOORS: CORE CONSTRUCTION

.1 Form face sheets for exterior doors from 16 ga (1.2 mm) sheet steel with polyurethane core laminated under pressure to face sheets.
.2 Form face sheets for interior doors from 18 ga. (1.0 mm) sheet steel with honeycomb core laminated under pressure to face sheets.

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 INSTALLATION GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.
.2 Secure anchorages and connections to adjacent construction.
.3 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 wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Install transition strip air barrier at perimeter of all frames.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 – Finish Door Hardware.

.2 Provide even margins between doors and jambs and doors and finished floor as follows.

.1 Hinge side: 1.0 mm.

.2 Latchside and head: 1.5 mm.

.3 Finished floor, top of carpet and thresholds: 13 mm.

.3 Adjust operable parts for correct function.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

End Of Section

Part 1 General

1.1 RELATED SECTIONS

.1 Section 06 10 00 Rough Carpentry
.2 Section 07 21 16 Blanket Insulation.
.3 Section 07 27 00 Air Barrier Transition Strip
.4 Section 07 90 00 Joint Sealing
.5 Section 08 11 17 Aluminum Doors
.6 Section 08 80 50 Glazing.

1.2 REFERENCES

.1 Aluminum Association (AA).
  .1 DAF 45-03, Designation System for Aluminum Finishes.
  .2 American Architectural Manufacturers Association (AAMA).
  .3 AAMA 609-93, Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.
.2 American Society for Testing and Materials International, (ASTM).
  .1 ASTM E330-02, 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 CGSB 1.40-97, Primer, Structural Steel, Oil Alkyd Type.
  .2 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
  .3 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.
.4 Canadian Standards Association (CSA International).
  .1 CAN/CSA-G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  .2 CAN/CSA G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 SYSTEM DESCRIPTION

.1 Design frames and doors in exterior walls to:
  .1 Accommodate expansion and contraction within service temperature range of -35 to 35 degrees C.
  .2 Limit deflection of mullions to maximum 1/175th of clear span when tested to ASTM E330 under wind load of 1.2 kpa.
  .3 Movement within system.
  .4 Movement between system and perimeter framing components or substrate.
.2 Size glass thickness and glass unit dimensions to limits in accordance with CAN/CGSB-12.20.
.3 Provide continuous air barrier and vapour retarder through door system. Primarily in line with inside pane of glass and heel bead of glazing compound.

1.4 SUBMITTALS – PRODUCT DATA

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 – Submittal Procedures.

1.5 SHOP DRAWINGS

.1 Indicate materials and profiles and provide full-size, scaled details of components for each type of door and frame. Indicate:
  .1 Interior trim and exterior junctions with adjacent construction.
  .2 Junctions between combination units.
  .3 Elevations of units.
  .4 Core thicknesses of components.
  .5 Type and location of exposed finishes, method of anchorage, number of anchors, supports, reinforcement, and accessories.
  .6 Location of caulking.

.7 Each type of door system including location.
.8 Arrangement of hardware and required clearances.

.2 Submit catalogue details for each type of door and frame illustrating profiles, dimensions and methods of assembly.

1.6 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manuals.

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Protection:
.1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Do not use coatings that shall become hard to remove or leave residue.
.2 Leave protective covering in place until final cleaning of building.

Part 2 Products

2.1 DESCRIPTION

.1 Non-thermally broken, aluminum framed, windows with single pane glass units with concealed tamperproof fasteners.

2.2 MANUFACTURER

.1 Work of this section shall be provided by one of the following manufacturer's
.1 Design based on
Kawneer
.1 VT 450 Series (Interior)
all other manufactures to comply with all aspects of this specifications
.2 Alumicor
.3 Oldcastle Building Envelope
.4 Windspec Inc.
.5 United States Aluminum Commercial Group
.6 Alwind Industries Ltd
.7 Or approved alternate

2.3 DESIGN CRITERIA

.1 Design Aluminum components to CAN/CSA S157.

.2 Fixed Window Classification: To CAN/CSA A440/A4440.1

2.4 WINDOW MATERIALS

.1 Main Frame: Extruded aluminum: To ASTM B221, 6063 alloy with T5 or T6 temper.

.2 Insulating glass units: In accordance with Section 08 80 50 Glazing

2.5 WINDOW FABRICATION

.1 Fabricate windows to CAN/CSA A440/A440.1.
.1 glazing in accordance with Section 08 80 50 – Glazing.

.2 Construct units square, plumb and free from distortion, waves, twists, buckles or other defects detrimental to performance or appearance.
.1 Brace frames to maintain squareness and rigidity during installation.

.3 Fabricate units square and true with tolerance of plus or minus 1.5 mm maximum for units with diagonal measurement of 1800 mm maximum and plus or minus 3 mm maximum for units with diagonal measurement greater than 1800 mm.

.4 Accurately fit and secure joints and corners.

.1 Ensure joints are flush, hairline, and weatherproof.

.5 Face dimensions detailed are maximum permissible sizes.

.6 Use only concealed tamperproof fasteners

.1 Where fasteners cannot be concealed, countersunk screws finished to match adjacent material may be used upon receipt of written approval from Consultant.

.7 Visible manufacturer's labels are not permitted.

2.6 ACCESSORIES

.1 Gasketing: Silicone compatible rubber or extruded silicone gaskets.

.2 Sealant: To CAN/CGSB-19.13, Class 40, one-component, cold-applied, non-sagging silicone.

.3 Sealant Bond Breaker: Open cell foam backer rod sized to suit project requirements.

.4 Weatherstripping: Polypropylene woven pile.

.5 Flashings: 3 mm (0.125 inches) thick aluminum flashing to profiles indicated

.6 Liquid Foam Insulation: Single component, moisture cure, low expansion rate spray-in-place polyurethane liquid foam insulation to ULC-S710.1 and in accordance with manufacturer's written recommendations.

.7 Aluminum Sill: Profile per drawings, supplied by manufacturer.

2.7 FINISHES

.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.

1. Aluminum framing: Clear anodized aluminum finish to Aluminum Association AA-M12C22A41, 0.7 mils coating thickness.

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 INSTALLATION

.1 Set frames plumb, square, level at correct elevation in alignment with adjacent work.

.2 Anchor securely.

.3 Install doors and hardware in accordance with hardware templates and manufacturer's instructions.

.4 Adjust operable parts for correct function.

.5 Make allowances for deflection of structure to ensure that structural loads are not transmitted to frames.

.6 Install exterior aluminum grilles and screens where noted on drawings.

.7 Install opening units where indicated on drawings.

.8 Install sun shades where indicated on drawings.

3.3 GLAZING

.1 Glaze aluminum doors and frames in accordance with Section 08 80 50 - Glazing.

3.4 CAULKING

.1 Seal joints to provide weathertight seal at outside and air, vapour seal at inside.

.2 Apply sealant in accordance with Section 07 90 0 - Joint Sealing. Conceal sealant within the aluminum work except where exposed use is permitted by Consultant.

3.5 CLEANING

.1 Perform cleaning of aluminum components in accordance with AAMA 609.1 - Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.

.2 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

.3 Clean aluminum with damp rag and approved non-abrasive cleaner.

.4 Remove traces of primer, caulking, epoxy and filler materials; clean doors and frames.

.5 Clean glass and glazing materials with approved non-abrasive cleaner.

.6 Upon completion of installation of this section, remove surplus materials, rubbish, tools and equipment barriers.

End Of Section

Part 1 General

1.1 RELATED SECTIONS

.1 Section 06 10 00 Rough Carpentry
.2 Section 07 21 16 Blanket Insulation.
.3 Section 07 27 00 Air Barrier Transition Strip
.4 Section 07 90 00 Joint Sealing
.5 Section 08 11 16 Aluminum Window Framing
.6 Section 08 44 13 Glazed Aluminum Curtain Wall
.7 Section 08 80 50 Glazing
.8 Finish Hardware: Section 08 71 00

1.2 REFERENCES

.1 Aluminum Association (AA)
  .1 DAF 45 2003, Designation System For Aluminum Finishes.
.2 American Architectural Manufacturers Association (AAMA).
  .1 AAMA-501-2005, Methods of Test for Exterior Walls.
  .2 AAMA-2603-2013, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
  .3 AAMA-2604-2013, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
  .4 AAMA-2605-2013, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
  .5 AAMA CW DG-1-96, Aluminum Curtain Wall Design Guide Manual.
  .6 AAMA CW-10-2012, Care and Handling of Architectural Aluminum From Shop to Site.
  .7 AAMA CW-11-1985, Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing.
  .8 AAMA-TIR A1-2004, Sound Control for Fenestration Products.
.3 ASTM International (ASTM).
  .1 ASTM A653 / A653M – 09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  .2 ASTM B209-2010, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  .3 ASTM B221-2013, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  .4 ASTM C612 – 2014, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  .5 ASTM E283-2012, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  .6 ASTM E331-2009, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
  .7 ASTM E413-04, Classification for Rating Sound Insulation.
  .8 ASTM E1105-2008, 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.
  .9 ASTM D2240-2010, Standard Test Method for Rubber Property—Durometer Hardness.
.4 Canadian General Standards Board (CGSB).
  .1 CAN/CGSB-12.8-97, Insulating Glass Units.
  .2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.

.3 CAN/CGSB-19.13-M87, Sealing Compound, One-Component, Elastomeric, Chemical Curing.

.5 CSA International (CSA)
- .1 CAN/CSA-S157-2005, Strength Design in Aluminum.
- .2 CAN/CSA-S136-2007, North American Specification for the Design of Cold-Formed Steel Structural Members.
- .3 CAN/CSA W59.2-M1991R2003, Welded Aluminum Construction.

.6 Environmental Choice Program (ECP)
- .1 CCD-45-1995, Sealants and Caulking Compounds.

1.3 PERFORMANCE REQUIREMENTS

.1 General Performance: Aluminum-framed entrance system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

.2 Wind loads: Provide entrance system; include anchorage, capable of withstanding wind load design pressures in accordance to Ontario Building Code.

.3 Air Infiltration: For single acting offset pivot or butt hung entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E 283 at a pressure differential of 1.57 psf (75 Pa) for single doors and pairs of doors. A single 3'0" x 7'0" (915 mm x 2134 mm) entrance door and frame shall not exceed 1.0 cfm/ft^2. A pair of 6'0" x 7'0" (1830 mm x 2134 mm) entrance doors and frame shall not exceed 1.0 cfm/ft^2.

.4 Structural Performance: Corner strength shall be tested per manufacture dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity.

.5 Thermal Performance: Computer simulation testing shall be in accordance with NFRC 100/200/500 and AAMA 507-03.

1.4 SUBMITTALS – PRODUCT DATA

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures.

.2 Product Data: Submit product data including manufacturer’s literature for aluminum, panels, styles, rails , components and accessories, indicating compliance with specified requirements and material characteristics.
- .1 Submit list on aluminum door manufacturer’s letterhead of materials, components and accessories to be incorporated into Work.
- .2 Include product names, types and series numbers.
- .3 Include contact information for manufacturer and their representative for this Project.

.3 Samples:
- .1 Submit duplicate (12 x 12 inches) sample sections showing prefinished aluminum surface, finish, colour and texture, and including section of infill panel.
  - .1 Include corner sample of each type of door.

.4 Test Reports:
- .1 Submit test reports showing compliance with specified performance characteristics and physical properties including air infiltration, water infiltration and structural performance.

.5 Field Reports: Submit manufacturer’s field reports within 3 days of manufacturer representatives site visit and inspection.

Installer Qualification:
- .1 Submit letter verifying installer's experience with work similar to work of this section.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.

.2 Shop Drawings: Submit drawings stamped and signed by Professional Engineer licensed in Ontario, Canada.

.3 Shop drawings to indicate materials and profiles and provide full-size, scaled details of components for each type of door and frame. Indicate:

.1 Core thicknesses of components.\

.2 Type and location of exposed finishes.

.3 Size of door opening and tolerances.

.4 Arrangement of hardware and required clearances.

1.6 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Supply maintenance data for curtain wall for incorporation into manual specified in Section 01 78 00 - Closeout Procedures & Submittals.

.2 Record Documentation: In accordance with Section 01 78 00 - Closeout Procedures & Submittals.

.1 List materials used in curtain wall work.

.2 Warranty: Submit warranty documents specified.

1.7 QUALITY ASSURANCE

1. Installer Qualifications: Installer who has had successful experience with installation of the same or similar systems required for the project and other projects of similar size and scope.

.2 Source Limitations: Obtain aluminum curtain wall system through one source from a single manufacturer.

.3 Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

.4 Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

1.8 PROJECT CONDITIONS

.1 Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver material in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver glazed aluminum curtain wall materials and components in manufacturer's original packaging with identification labels intact and in sizes to suit project.

.2 Material Handling: To AAMA CW-10.

.3 Storage and Handling Requirements: Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

.1 Material storage: To AAMA CW-10.

1.10 WARRANTY

.1 Project Warranty: Refer to Contract Conditions for project warranty provisions.

.2 Manufacturer’s warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is

in addition to and not intended to limit other rights Owner may have under Contract Conditions.

.3 Warranty period: 2 years commencing on Date of Substantial Performance of Work.
.1 Insulating glass units: 10 years, on Date of Substantial Performance of Work.

Part 2 Products

2.1 MANUFACTURER

.1 Work of this section shall be provided by one of the following manufacturer's
.1 Design based on
Kawneer
.1 Insulated Door: Kawneer 500T
.2 Non-Thermal: Kawneer 500 Standard Door
all other manufactures to comply with all aspects of this specifications
.2 Alumicor
.3 Oldcastle Building Envelope
.4 Windspec Inc.
.5 United States Aluminum Commercial Group
.6 Or approved alternate

2.2 DESCRIPTION

.1 Aluminum-framed swing door with glass insert suitable for inclusion in curtain wall system
.2 The door stile and rail face dimensions of the thermal entrance door shall be as follows:
.1 As per drawings.
.3 Major portions of the door members to be 0.125" (3.2 mm) nominal in thickness and glazing molding to be 0.05" (1.3 mm) thick.
.4 Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
.5 Provide adjustable glass jacks to help center the glass in the door opening

2.3 MATERIALS

.1 Aluminum Extrusions: Alloy and temper recommended by aluminum entrance door manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090" wall thickness at any location for the main frame and door leaf members.
.2 Aluminum sheet alloy: Shall meet the requirements of ASTM B209.
.3 Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum entrance door members, trim hardware, anchors, and other components.
.4 Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
.5 Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
.6 Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701
.7 Insulating glass units for exterior glazed door: In accordance with Section 08 80 50-Glazing.

2.4 DOOR FABRICATION

.1 Do aluminum welding to CAN/CSA W59.2.
.2 Fabricate aluminum assemblies of extruded sections to sizes and profiles indicated.

.1 Ensure stiles and rails are tubular extrusions designed for mechanical shear block fastening in combination with SIGMA deep penetration plug welds and fillet welds at all stile/rail connections.

.3 Door Thickness: 1¾"

.4 Construct doors square, plumb and free from distortion, waves, twists, buckles or other defects detrimental to performance or appearance.

.5 Fabricate infill panels of aluminum sheet laminated to marine grade plywood.
- .1 Aluminum sheet minimum thickness 3mm
- .2 Marine grade plywood thickness 19mm

.6 Accurately fit and secure joints and corners.
- .1 Ensure joints are flush and hairline

.7 Use only concealed or semi-concealed fasteners
- .1 Where fasteners cannot be concealed, countersunk screws finished to match adjacent material may be used.

.8 Install door hardware.

.9 Locate manufacturer's labels on exterior side of door bottom rail.

2.5 ALUMINUM FINISHES

.1 Exterior and Interior exposed aluminum surfaces: To AA DAF-45-M12C22A31, Architectural Class II, .1 Clear Anodized.

2.6 HARDWARE

.1 Hardware: In accordance with Section 08 71 00 - Finish Hardware Schedule

2.7 ACCESSORIES

.1 Gasketing: To CCD-45 EPDM gaskets.

.2 Setting Blocks: To CCD-45 and ASTM D2240

.3 Spacers: To CCD-45 and ASTM D2240,

.4 Sealant: To CAN/CGSB-19.13, Class 40, one-component, cold-applied, non-sagging silicone. Silone as per manufacturer's recommendations

.5 Sealant Bond Breaker: Open cell foam backer rod sized to suit project requirements.

Part 3 Products

3.1 EXAMINATION

.1 Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated installation.
- .1 Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
- .2 Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed entrance doors, hardware, accessories, and other components.

.2 Install aluminum-framed 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.

.3 Set sill threshold in bed of sealant, as indicated, for weather tight construction.

.4 Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING AND PROTECTION

.1 Clean aluminum surfaces immediately after installing aluminum-framed entrance doors. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

.2 Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

.3 Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

End Of Section

1.1 RELATED REQUIREMENTS

.1 Overhead Door Operators: Section 08 73 10

1.2 REFERENCES

.1 ASTM D 1929 - Ignition temperature test to determine flash and ignition temperature of foamed plastics.

.2 ASTM E 84 - Tunnel test for flame spread and smoke developed index.

.3 ASTM E 413 - Classification for Rating Sound Insulation

.4 ASTM E 1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for doors, hardware, and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate sizes, service rating, types, materials, operating mechanisms, glazing locations and details, hardware and accessories, required clearances.

.4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.5 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturers Reports:

.1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for sectional metal doors for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 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 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.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect sectional metal doors, hardware and accessories from [nicks, scratches, and blemishes].

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials.

1.7 WARRANTY

.1 Insulated Metal Doors Warranty: Manufacturer's limited door System warranty for 10 year against cracking, splitting or deterioration of steel skin due to rust-through.

.2 Glazed Sectional Overhead Doors Warranty: 1 year.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Design exterior door assembly to withstand wind load of 1 kPa with a maximum horizontal deflection of 1/240 of opening width.

.2 Design door panel assemblies with thermal insulation factor indicated.

.3 Single-Source Responsibility: Provide doors, tracks and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

2.2 MATERIALS

.1 Insulated Metal Doors:

- .1 Galvanized Steel Sheet: ASTM A653/A653M, Structural Quality, G60 coating class
- .2 Glazing: Insulated Glass
- .3 Door Sections:
  - .1 Type: Mirco-grooved sandwich style
  - .2 Panel Thickness: 2 inches (51 mm).
  - .3 Material: Galvanized steel
  - .4 Gauge: 26 gauge exterior skin with 27 gauge interior skin, polyurethane core sections
  - .5 Thickness: Nominally 2 inches.
  - .6 Rails: Tongue and groove
  - .7 End caps: Wrap-around box style, 20 gauge galvanized steel, full height of section.
  - .8 Insulation: 95 percent closed cell, foamed-in-place polyurethane with thermal break.
  - .9 Glazed section: Full View type, Aluminum framed.
  - .10 Standard cycle spring: 50,000 cycles.
- .4 Tracks
  - .1 3 inch wide, rolled-formed 13 gauage galvanized steel, with galvanized steel mounting brackets
- .5 Hinge & Roller Assemblies: Door track rollers to be manufacturer's standard rollers.
- .6 Spring Counterbalance:
  - .1 Oil Tempered torsion springs mounted on cross-header shaft supported by galvanized steel ball bearing end plates and centre brackets as required.
  - .2 Counterbalance transferred to doors via aircraft quality braided steel lift cables.
- .7 Bottom Weatherstripping: Vinyl weatherseal, full width of door.
- .8 Head and Jamb Weatherstripping: Flexible one piece vinyl extrusions.
- .9 Electric Operator: As per section 08 73 10 Overhead Door Operators.
- .10 Safety Device: As per section 08 73 10 Overhead Door Operators.
- .11 Finish:
  - .1 Exterior panel surface: Baked-on enamel primer and polyester finish Coat. Colour to be selected from manufacturer's standard range.
  - .2 Interior panel surface: Baked-on polyester primer.
- .12 Acceptable Product:
  - .1 CHI -3216
  - .2 Or approved alternate

Part 3 EXECUTION

3.1 EXAMINATION

.1 Do not begin installation until openings have been properly prepared.

.2 Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

.3 Verify electric power is available and of correct characteristics.

.4 If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

.1 Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.

.2 Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.

.3 Anchor assembly to wall construction and building framing without distortion or stress.

.4 Securely brace door tracks suspended from structure. Secure tracks to structural members only.

.5 Fit and align door assembly including hardware.

.6 Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

.7 Instruct Owner’s personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

.1 Test for proper operation and adjust as necessary to provide proper operation without binding or distortion

.2 Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

.1 Clean doors, frames and glass using non-abrasive materials and methods recommended by manufacturer.

.2 Remove labels and visible markings.

.3 Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

.1 Do not permit construction traffic through overhead door openings after adjustment and cleaning.

.2 Protect installed products until completion of project.

3.7 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

- .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product within 3 days of review.
- .2 Submit 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 Ensure manufacturer's representative is present before and during critical periods of installation.
- .4 Schedule site visits to review Work at stages listed:

.1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.

.2 Upon completion of Work, after cleaning is carried out.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 10 00 Rough Carpentry
.2 Section 07 21 16 Blanket Insulation.
.3 Section 07 27 00 Air Barrier Transition Strip
.4 Section 07 90 00 Joint Sealing
.6 Section 08 80 50 Glazing.

1.2 REFERENCES

.1 Aluminum Association (AA)

.1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

.2 American Architectural Manufacturers Association (AAMA)

.1 AAMA CW-10-04, Care and Handling of Architectural Aluminum From Shop to Site.
.2 AAMA 501-05, Methods of Test for Exterior Walls.

.3 ASTM International

.1 ASTM A123/A123M-09, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
.2 ASTM B209-07, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
.3 ASTM B221-08, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.108-M89, Bituminous Solvent Type Paint.
.2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.

.5 CSA International

.1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
.2 CAN/CSA-S157/S157.1-05, Strength Design in Aluminum/Commentary on CAN/CSA-S157, Strength Design in Aluminum.
.3 CSA W59.2-M1991(R2008), Welded Aluminum Construction.

.6 Society for Protective Coatings (SSPC)

.1 SSPC - Paint 20-02(R2004), Zinc Rich Coating, Type I - Inorganic and Type II - Organic.

.7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for curtain wall components, anchorage and fasteners, glass and infill, and internal drainage details and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer licensed in Province of Ontario, Canada.

.2 Indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anchor details anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Submit 2 samples 12” x 12” in size illustrating prefinished aluminum surface, finish, colour, texture, specified glass units, insulated infill panels, glazing materials illustrating edge and corner.

.5 Delegated Design Submittals:

.1 Include framing member structural and physical characteristics, calculations, dimensional limitations, special installation requirements.

.6 Test Reports:

.1 Submit substantiating engineering data, test results of previous tests [by independent laboratory] which purport to meet performance criteria, and supportive data.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 – Closeout Procedures & Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for glazed aluminum curtain wall for incorporation into manual.

1.5 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.

.3 Storage and Handling Requirements:

.1 Handle work of this Section in accordance with AAMA CW-10.

.2 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.3 Store and protect aluminum glazed curtain wall components from nicks, scratches, and blemishes.

.4 Protect prefinished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

.5 Replace defective or damaged materials with new.

1.6 AMBIENT CONDITIONS

.1 Install sealants when ambient and surface temperature is above 5 degrees C minimum.

.2 Maintain this minimum temperature during and for 48 hours minimum after installation of sealants.

1.7 WARRANTY

.1 Contractor hereby warrants that glazed aluminum curtain wall shall function as specified in accordance with CCDC 24, but for 60 months.

Part 2 Products

2.1 SYSTEMS

.1 Description:

.1 Vertical glazed aluminum curtain wall system includes thermally broken tubular aluminum sections with self supporting framing, shop fabricated, factory prefinished, vision glass, spandrel infill, column covers and panning, related flashings, anchorage and attachment devices.

.2 Assembled system to permit re-glazing of individual glass units from exterior without requiring removal of structural mullion sections.

.2 Performance Requirements:

.1 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.

.2 Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable codes.

.3 Limit mullion deflection to flexure limit of glass with full recovery of glazing materials.

.4 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.

.5 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.

.6 Limit air infiltration through assembly to 0.0003 $m^3/s/m^2$ of wall area, measured at a reference differential pressure across assembly of 75 Pa as measured in accordance with AAMA 501.

.7 Vapour seal with interior atmospheric pressure of 25 mm sp, 22 degrees C, 40% RH: no failure.

.8 Water leakage: none, when measured to AAMA 501.

.9 Ensure system allows for expansion and contraction within system components when temperature range is 95 degrees C 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 Reinforce curtain wall system to accommodate window washing guide rails.

.1 Supply sufficiently rigid anchors to resist loads caused by equipment platform, without damage to wall system.

2.2 MATERIALS

.1 Extruded aluminum: to ASTM B221.
.2 Sheet aluminum: to ASTM B209.
.3 Sheet steel: to CSA S136
.4 Steel sections: to CSA G40.20/G40.21; shaped to suit mullion sections.
.5 Anchors: 3-way adjustable hot-dip galvanized cast iron.
.6 Fasteners: stainless, finish to match curtain wall.
.7 Bituminous paint: CAN/CGSB 1.108, Type 1, without thinner.
.8 Insulated glass units: to CAN/CGSB-12.8, double glazed with outer pane of 6 mm thick Solarban 60 Softcoat Low E Glazing, or approved alternate, and inner pane of 6 mm thick clear float glass. Provide argon gas filled inter-cavity space with thickness of 13 mm; overall total thickness 25 mm.
.9 Spandrel Panels: 6 mm thick heat strengthened Opacicoat, or approved alternate, complete with galvanized back pan. Insulate back pan.
.10 Sealant: silicone type, as recommended by Curtain Wall Manufacturer.

2.3 COMPONENTS

.1 Curtain Wall Framing:
  .1 Kawneer 1600 UT, System 1, 2 ½" x 7.5" framing, outside glazed clear anodized aluminum.
  .2 Alumicor 2600, 2 ½" x 7.5": framing, outside glazed, clear anodized aluminum.
  .3 or approved alternate
.2 Vapour retarder: curtain wall manufacturer's standard

.3 Air barrier: Rolled, Self-Adhering Air/Vapour Barrier Membrane: Polymeric air/vapour barrier membrane protected by release paper on cross-laminated polyethylene carrier film with exposed polymeric membrane strips on both sides protected by pull-off release strips.
  .1 Performance Based Specification: Air/Vapour barrier membrane shall have the following characteristics:
    .1 Color:
      1) Carrier Film: White.
      2) Polymeric Membrane: Black.
    .2 Thickness: 40 mils (1mm).
    .3 Tensile Strength Film:
      1) ASTM D 412, modified (MD): 4,000 psi (27.6 MPa).
      2) ASTM D 882 (MD): 23.5 lb/in. (4.1 N/mm).
    .4 Elongation Film:
      1) ASTM D 412, modified (MD, %): 400 (Typical).
      2) ASTM D 882 (MD, %): 400 Min.
    .5 Puncture Resistance, ASTM E 154: 40 lbf (178 N) Min.
    .6 Water Vapour Permeance (free film), ASTM E 96, Procedure B: 0.035 Perms.
    .7 Water Vapour Permeance (% by weight):
      1) ASTM D 1970: 0.25 Max.
      2) ASTM D 570-81: 0.1 Max.
  .2 Acceptable Products: W.R. Meadows Air Shield Meadows Sealtight Airshield, Grace Perm-A-Barrier System 4000, Advanced Coatings Rub-R-Wall SA or approved alternate.
  .3 At perimeter transitions between curtain wall framing and existing construction provide transition stripping material in 6" (150 mm) widths.

2.4 FABRICATION

.1 Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
.2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
.3 Prepare components to receive anchor devices. Install anchors.
.4 Arrange fasteners and attachments to ensure concealment from view.
.5 Reinforce interior horizontal head rail to receive roller shade track brackets and attachments.
.6 Reinforce framing members for external imposed loads.
.7 Visible manufacturer's identification labels not permitted.
.8 Finishes:

.1 Interior and Exterior exposed aluminum column covers and panning: clear anodized, 1/8" (3 mm) thickness.
.2 Shop and touch-up primer for steel components: SSPC 25 Paint red oxide.
.1 VOC limit: 250 g/L maximum to SCAQMD Rule 1113.
.3 Touch-up primer for galvanized steel surfaces: SSPC 20 Paint zinc rich.
.1 VOC limit: 250 g/L maximum to SCAQMD Rule 1113.
.4 Concealed steel items: galvanized in accordance with ASTM A123 to 600 gm/m^2]
.5 Apply 1 coat of bituminous paint to concealed aluminum [and steel] surfaces in contact with cementitious or dissimilar materials.
.1 VOC limit: 350 g/L maximum to SCAQMD Rule 1113.

2.5 SOURCE QUALITY CONTROL

.1 Manufacturer qualifications: company specializing in manufacturing the products specified in this section with minimum 3 years experience.
.2 Installer qualifications: company specializing in performing the work of this section with minimum 5 years experience.
.3 Design structural support framing components to CAN/CSA-S157 under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the Province of Ontario
.4 Perform welding Work in accordance with CSA W59.2.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum curtain wall installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.
.2 Verify dimensions, tolerances, and method of attachment with other work.
.3 Verify wall openings and adjoining air barrier and vapour retarder materials are ready to receive work of this Section.
.4 Inform Consultant of unacceptable conditions immediately upon discovery.
.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

.1 Install curtain wall system in accordance with manufacturer's instructions.
.2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
.3 Use alignment attachments and shims to permanently fasten system to building structure. Clean weld surfaces; apply protective primer to field welds and adjacent surfaces.

.4 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.
.5 Use thermal isolation where components penetrate or disrupt building insulation.
.6 Install sill flashings where indicated.
.7 Co-ordinate attachment and seal of perimeter air barrier and vapour retarder materials.
.8 Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
.9 Install fire-safing in areas as indicated.
.10 Install glass in accordance with curtain wall manufacturer's instructions.
.11 Install perimeter sealant.

3.3 SITE TOLERANCES

.1 Maximum variation from plumb: 1.5 mm/m non-cumulative or 12 mm/30 m, whichever is less.
.2 Maximum misalignment of two adjoining members abutting in plane: 0.8 mm.
.3 Maximum sealant space between curtain wall and adjacent construction: 13 mm.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer of curtain wall and glass verifying compliance of Work, in handling, installing, applying, protecting and cleaning of products, and submit written reports in acceptable format to verify compliance of Work with Contract within 3 days of review.
.2 Submit 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 Ensure manufacturer's representative of curtain wall and of glass is present before and during critical periods of installation.
.4 Schedule site visits to review Work at stages listed:
.1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of Work, after cleaning is carried out.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.
.2 Remove protective material from prefinished aluminum surfaces.
.3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
.4 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
.5 Final Cleaning: upon completion of this section remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.
.2 Repair damage to adjacent materials caused by glazed aluminum curtain wall installation at no additional cost to Owner.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Metal Doors & Frames: Section 08 11 00

.2 Aluminium Doors & frames: Section 08 11 16

1.2 MAINTENANCE DATA

.1 Provide operation and maintenance data for door closers, locksets, door holders and fire exit hardware for incorporation into manual specified in Section 01 78 00 Closeout Procedures & Submittals

.2 Brief maintenance staff regarding proper care, cleaning, and general maintenance.

1.3 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 Closeout Procedures & Submittals

.2 Supply two sets of wrenches for door closers, locksets and fire exit hardware.

1.4 DELIVERY AND STORAGE

.1 Store finishing hardware in locked, clean and dry area.

.2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

Part 2 Products

2.1 HARDWARE ITEMS

.1 Hardware items shall be supplied and installed in accordance with attached Hardware Schedule.

Part 3 Execution

3.1 INSTALLATION INSTRUCTIONS

.1 Obtain manufacturer's instructions for proper installation of each hardware component.

.2 Examine all work to receive finishing hardware when ready and report any unsuitable condition to the Consultant prior to continuing.

.3 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.4 Remove and reinstall new and existing hardware as necessary to allow finish painting.

.5 All work shall be installed plumb and true and secured with proper fastenings.

END OF SECTION

Finish Hardware Schedule

for

Brantford Animal Shelter

Issued For Tender

Architect: ROA studio inc.
67 King Street West
Chatham, ON N7M 1C7
519-397-0943

Contractor:

Schedule By: jpw systems ltd.
30 Doan Drive
Komoka, ON N0L 1R0
info@jpwsystems.ca
519-474-9797

Consultant: Paul Cumper, AHC, CFDAI - paulc@jpwsystems.ca
519-474-9797
Coordinator: Donna Hayes - donnah@jpwsystems.ca
519-474-9797

Version 10-Sept.-24

Previous 12-Aug.-24

PART 1: GENERAL

1.01 GENERAL REQUIREMENTS

A. Refer to and be governed by the requirements of Division 1.

1.02 SCOPE OF THE WORK

A. The hardware supplier shall supply and install all finish hardware items as specified herein including, but not limited to, automatic door operators, electric locksets, current transfer devices, integration modules, low voltage wire, and power supplies. All low voltage termination and commissioning for electrified hardware items only, shall be completed by the hardware supplier. All access control devices, card readers, door contacts, low voltage wire for access control/security items shall be supplied and installed by the security system provider.

B. The hardware supplier will be required to provide the Contractor with an electric door hardware elevation, point to point wiring diagram, and riser diagram for each electrified hardware opening. Schematic diagrams must be approved by the consultant prior to commencement of any work.

C. The hardware supplier shall meet with the Contractor, subcontractors and owner's representatives to instruct and coordinate the supply and installation of all electric hardware components.

1.03 QUALITY ASSURANCE

A. Regulatory Agencies

1. Supply only hardware as required by jurisdictional codes.
2. Install only U.L.C. or U.L.I. listed hardware for fire rated construction.
3. Install only U.L.C. and/or C.S.A. listed electrical components.

1.04 REFERENCES

A. Provide finish hardware to meet or exceed the requirements set forth by the following publications.

1. NFPA-80 Standard for Fire Doors and Fire Windows, 2007 Edition
2. BHMA 156.18 Materials and Finishes, 2003 Edition
3. DHI Sequence and Format for the Hardware Schedule, 2000 Edition
4. DHI Keying Systems and Nomenclature, 2004 Edition
5. DHI Installation of Guide for Doors and Hardware, 2004 Edition

1.05 SUBMITTALS

A. Samples

Submit samples of each hardware item if requested by architect.

B. Templates

Submit templates to Contractor for use by fabricators and installers.

C. Maintenance and Operating Hardware

Submit maintenance, operating and installation instructions for installation requirements and for incorporation into Project Data Books.

D. Schedules

1. The hardware supplier shall submit one (1) digital copy of the hardware schedule to the Consultant through the General Contractor for review. After the Consultant's review, supply the required number of hardware schedules to the necessary trades/suppliers. If requested by the Consultant, samples of material to be supplied shall be forwarded to the Consultant for his use until the project completion.

2. Provide one (1) digital copy of description of operations documentation, system riser diagram, door elevation and point to point drawings for the owner's review and approval prior to the commencement of electrified hardware and systems installation.

3. Submit the specified number of copies of the final hardware schedule for incorporation into the Project Data Books as described in the Contract Closeout subsection of Section 01700, Contract Closeout.

1.06 WARRANTY

A. Provide finish hardware items free from defects in materials and workmanship for the minimum period required by section 01700 Contract Closeout. The following hardware item(s) shall have an additional extended manufacturer's warranty; dates are from the date of substantial completion.

1. Mechanical Door Closers – 5 years

1.07 DELIVERY, STORAGE AND HANDLING

A. Package hardware in protective coverings and label each piece with a description of contents and location of installation. Refer to approved finishing hardware schedule and to door number where applicable.

B. Deliver all hardware to building site and to the location as designated by Contractor.

PART 2: PRODUCTS

2.01 MATERIALS

A. Finishing hardware fabricated of the same material shall be consistent in color and finish throughout.

B. Supply all necessary screws, bolts, expansion shields, inserts and other items and of same finish and color as required for a complete installation and for proper functioning.

C. The final finishing hardware schedule shall be forwarded to Division 15 and 16 for coordination with mechanical and electrical components of the work complete with riser and schematic wiring diagrams.

2.02 MANUFACTURERS

A. Provide hardware of the best quality and free from defects in materials, finish and workmanship.

B. Listed below are the manufacturers whose products are specified in the hardware schedule.

C. Below is a list of products that are to be supplied to the project, to match existing hardware standards already in place. No substitutions will be allowed unless approved by Consultant.

Mortar Boxes: Provide 16ga welded steel back boxes with a minimum thickness of 2mm for all electrified hardware as listed. All boxes are to be supplied complete with 12mm EMT connectors on both ends of the box. Boxes are to be tack welded in place by frame supplier prior to their arrival on site.

(TAC)	TA-6400 series	

Hinges: Provide ball bearing hinges complete with Philips head screws. Adjust and shim the hinges to provide 3mm clearances between the door and frame at the head and jambs. Adjust for any hinge bind to provide smooth quiet operation.

(McKinney)	T4A3386	Alternate FBB199/BB1199
	T4A3786	Alternate FBB168/BB1168
	TA2714	Alternate FBB179/BB1179
	TA2314	Alternate FBB191/BB1191

Exit Devices: Provide touch bar exit devices sized to suit door width.

(Sargent)	8893	Alternate 350 Von Duprin
	LD-8810	Alternate LD-98EO Von Duprin
	55-56-8510	Alternate QEL LX 35A Von Duprin
	55-56-8504	Alternate QEL LX 35 NL-OP Von Duprin
	L980A	no substitution

2.02 MANUFACTURERS – continued

Locksets: Mortise locks and latches are to be heavy duty construction, handed for each opening. Locks and latches must be field reversible for handing so that the lock case not need be opened. Provide locks and latches with latch bolts with appropriate throw dimensions for fire rated openings in accordance with NFPA-80 and the manufacturer's listings. current. Provide lockset and latch strike plates with lip to center dimensions sized to minimally clear all trim. Provide curved lip strikes at openings where the strike plate is required to clear all casing or door frame.

(Sargent)	8200	Alternate L9000 series Schlage
(Command Access)	LPM193EU x EL	no substitution

Door Closers: Surface door closers are to be surface mounted rack and pinion hydraulic door closers of heavy duty construction. Provide surface door closers with adjustable closing and latching speeds, and adjustable back check. After initial installation adjust each door closer for proper size, latching speed, closing speed, and back check. Openings where the door swings out of the room into the corridor or exterior shall have push side mounted closers. Provide appropriate soffit mounting adapters, shims, and adapter plates at openings where coordinators or weather strip interfere with the door closer mounting.

(LCN)	4000 series	no substitution

Barrier Free Operators: Provide fully automatic electro-mechanical swing door operators, completely self-contained units consisting of AC motor, high strength mechanical drive unit, solid state electro- control system, adjustable opening speed and adjustable hold open time. Provide CSA listing and provide ULC, cUL listing for fire rated openings. Provide full width headers width for operator headers at pairs of doors. Inactive door leaf manual closers shall be concealed in the operator header.

(Horton)	7900 series	Alternate Besam SW200i
	LE4100 series	no substitution

Door Pulls: Provide door pulls manufactured from stainless steel and chrome plated. Door pulls shall be installed so they do not interfere with the cylinder operation at scheduled openings.

(CBH)	H49-1800	no substitution
	H49-1802	no substitution
	7530B-1	no substitution
	7004	no substitution

Sound Seal/Weatehrstrip : Provide surface applied sound seal/weatherstrip. Sound seal must be installed to run continuous around the door opening to assist in the reduction of sound transmission.

(Pemko)	S773D	no substitution
(KN Crowder)	W-50S	no substitution
	W-38S	no substitution
	CT-52S	no substitution

Indicators:

(Camden)	CX-LED2/RG/55 (occ/vac)	no substitution
	CX-LED2/RG/56 (locked/unlocked)	no substitution
	CM-45/4	no substitution
	CM-45/8	no substitution
	CM-AF141SO	no substitution
	CM-AF501SO	no substitution
(TAC)	TA-3241-EP-LED	no substitution

Overhead stops:

(Glynn Johnson)	104S	Alternate 693S Sargent

Electric Strike:

(HES)	1006CLB	Alternate Von Duprin 6300

Integration Modules:

(TAC)	TA-2909-PIK	no substitution
	TA-2909-CAB	no substitution
	TA-2880-12	no substitution
	TA-2880-12 x TA-2673	no substitution
	TA-2880-12 x TA-2799	no substitution

2.03 FINISHES

A. Listed below is a description of finishes as listed in the hardware schedule.

626	brass/bronze - satin chrome plated
627	aluminum – mill finish
628	aluminum – satin, clear anodized
630	stainless steel - satin
652*	stainless steel – satin chromium plated
689	any material - painted aluminum

2.04 KEYING

A. Provide temporary cylinders keyed alike. All permanent cylinders are to be purchased from owners preferred local locksmith, installed by this section.

PART 3: EXECUTION

3.01 EXAMINATION

Before supplying any materials, check all Contract Documents, shop drawings site condition and other details of this Project to ensure that listed hardware is suitable for intended use and for dimensions. Inform the Consultant of inaccuracies or discrepancies in writing. The General Contractor shall perform the requirements of the four paragraphs below before the commencement of finish hardware installation.

A. Inspection of Door Frames

Immediately prior to the installation of hardware, verify the door frames have been properly installed. Ensure doors frames are installed level, plumb, and square and tightly fastened to the adjacent wall construction. Confirm door frames are the correct size, hand, and prepared for the correct hardware to suit the intended function and opening. Confirm door frames and labeled with the appropriate fire protection ratings where scheduled. Inspect door frames for damage and correctness. Repair, reinstall, or replace with new, damaged door frames. Confirm door frames are reinforced and prepared to receive mortised, template, and surface applied hardware items as scheduled in the approved finish hardware schedule.

B. Inspection of Door Leaves

Confirm door leaves are the correct size, hand and type where scheduled. Ensure that the correct fire protection ratings are identified where scheduled. Inspect door leaves from damage. Repair, or, replace with new, damaged door leaves. Verify door leaves are reinforced and prepared to receive, template, mortise, and surface applied hardware items as scheduled in the approved finish hardware schedule.

C. Preparation of Adjacent Work

Prior to the installation of hardware items, confirm painting and staining of doors and door frames is complete. Verify wash down of masonry wall is complete. Where the installation of finish flooring interferes with the installation of hardware strikes and other floor mounted, install finish flooring material before installing hardware items.

D. Inspection of Hardware Items

Prior to the installation of hardware items, examine each packaged hardware item, to confirm the correct size, hand, finish, accessories, quality, fasteners, and optional features are included as listed in the approved finish hardware schedule. Confirm voltages of electrified architectural hardware items match the requirements of the systems detailed in the approved finish hardware schedule, elevation diagrams, and schematic wiring diagrams.

3.02 INSTALLATION

Install hardware items in accordance with the listed manufacturer's recommended procedures and methods. Provide the installers with the DHI publication "Installation Guide for Doors and Hardware", as a guide during the hardware installation.

A. Fasteners

Install each hardware item with fasteners as required by the manufacturer's listing to obtain the required fire protection rating, and warranty requirements as stipulated in the manufacturer's listings. Mortised and surface applied hardware mounted to the door shall have the fastener holes drilled and tapped to suit the required thread size. Self-drilling self-tapping screws are not an acceptable means of fastening the finish hardware items.

B. Clearances

Install fire rated doors, frames, and hardware in accordance with the clearances listed in NFPA-80. Provide the following clearances and fire rated and non-fire rated openings:

1. 3/16" between top rail of door and frame head
2. 3/16" between lock stile of door and strike jamb of frame
3. 3/16" between hinge stile of door and hinge jamb of frame
4. 3/16" between meeting stiles of pairs of doors
5. 1/4" between bottom rail of door and top of threshold
6. 3/4" between bottom rail of door and finished floor material, except where hardware specifically requires other clearances to properly function.

C. Mounting Heights

Listed below are the locations at which hardware is to be installed, unless otherwise noted in the finish hardware schedule. All measurements are from the finish floor to the center line of each item.

current transfer	-	55" (unless noted otherwise)
latch sets (mortise)	-	40-5/16"
exit devices	-	41" centerline of push bar
deadlocks	-	34" centerline of strike
overhead stops	-	refer to finish hardware schedule
door pulls	-	to be confirmed with consultant
wall switches	-	36" – 39"

3.03 FIELD QUALITY CONTROL

A. Upon completion of the installation, verify that the finish hardware has been installed in accordance with the approved hardware schedule. Verify each door leaf open, closes, and latches properly. Inspect fire rated openings to confirm that the architectural hardware installed conforms to the requirements of NFPA-80. Test the electrified hardware as per approved descriptions of operation for proper function and design. Ensure that the electrified hardware systems work correctly and seamlessly with the fire alarm system, and access control system. Hardware found to be defective, damaged, or not installed correctly shall be repaired, or replaced with new to correct the hardware item to function as intended.

3.04 DEMONSTRATION

A. Provide owner's personnel with instruction and 4 hours of training on electrified architectural hardware and systems.

3.05 ADJUSTING AND CLEANING

A. Upon completion of the project ensure that architectural hardware has been left clean or paint, varnish, stain and other coatings. Remove all protective coverings from push plates, protection plates, door pulls, and exit devices. Adjust all door closers for proper closing strength, latching speed, and check, once at initial installation, and again after the balancing and commissioning of the building's HVAC system. Adjust strikes for locksets and exit devices to ensure proper latching in accordance with NFPA-80.

3.06 PROTECTION

A. Finish hardware is to be protected for quality, finish and function. Wrap lock, latch set, exit device trim and door pulls with cardboard, bubble wrap material to protect finish and product from damage throughout the construction period of the project. Remove hardware items prior to painting, staining, or re-touching of doors and frames.

Brantford Animal Shelter

Heading #1

1	pair doors	101	exterior from vestibule 101	RHRA

Type A 2 @ 38" x 84" x 2-1/4" insulclad aluminum doors / aluminum transom screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

6	hinges	T4A3386 5" x 4-1/2" NRP	630
2	current transfer	CEPT-10	630
2	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	key removable mullion	L980A x 86"	628
1	mortise cylinder	41 (removable mullion) (temporary for construction phase)	630
1	removable mullion bottom brkt	98-2525 (for L980A)	630
1	electric exit device	LC-55-56-8504J x 649 x 24V (rhr)	630
1	exit device	55-56-8510J x 649 x 24V (lhr)	630
1	rim cylinder	34 (temporary for construction phase)	630
1	rim cylinder	permanent cylinder by locksmith - supplied/installed by 08710	
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710 (for mullion)	
1	door pull	H49-1802 x 2-1/4" door (lhr)	652*
1	door pull	H49-1802 x 2-1/4" door (rhr)	652*
2	overhead stop	104S (concealed) (33-1/16"-39")	630
1	closer	4021 LONG x ST-3212 x mws (lh)	689
1	auto operator	LE4100 x 80" (push side mount) x prep for closer x 120V (lhr)	628
1	threshold	CT-45 x 84" x no holes	627
2	door sweep	W-38S x 38"	628
1	weatherstrip	perimeter weatherstrip integral to frame stop	
1	gasketing	S773D x 84" (apply to mullion for door to close against)	
1	reader	supplied/installed by others	
2	mounting box	4 x 4 edge	630
2	push button	CM-45/4 (push to open)	630
1	integration box	TA-2909-PIK (screw on cover plate)	
1	integration module	TA-2880-12 x TA-2673	
1	power supply	BPS-24-2	
1	battery	SLA12-4.5(2) (24V)	
1	wiring diagram	refer to wiring elevation DE01	

Heading #2

1	pair doors	102	vestibule 101 from lobby 102	LHR/RHR

Type B 38" x 84" x 1-3/4" aluminum door / aluminum transom screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

6	hinges	T4A3786 5" x 4-1/2" NRP	652
2	dummy exit rail	8893J	630
2	door pull	H49-1800 x 1-3/4" door	630
2	overhead stop	104S (concealed) (33-1/16"-39")	630
1	closer	4021 LONG x ST-3212 x mws (rh)	689
1	auto operator	LE4100 x 80" (push side mount) x prep for closer x 120V (rhr)	628
2	mounting box	4 x 4 edge	630
2	push button	CM-45/4 (push to open)	630
1	wiring diagram	refer to wiring elevation DE02	

Heading #3

1	sgle door	103	lobby 102 to universal washroom 103	LH

Type D 38" x 84" x 1-3/4" hm door / ps frame
slab door

1	mortar box	TA-6410 (to suit current transfer location)	
1	mortar box	TA-6410 (to suit door contact location)	
3	hinges	T4A3786 5" x 4"	652
1	current transfer	CEPT-10	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	lever trim	09-454 x 03A	630
1	electric lock	LPM193EU x EL CH x 24V (lh)	
1	mortise cylinder	41 x 106 cam (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	auto operator	7900 x 42" x parallel arm (pull side mount) x 120V (lh)	628
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
1	visual indicator-electrical	CX-LED2/RG/55 (occ/vac)	630
1	visual indicator-electrical	CX-LED2/RG/56 (locked/unlocked)	630
1	mounting box set	6M-5161-BFH	630
2	push button	CM-45/4 (push to open)	630
1	push button	CM-45/8 (push to lock)	630
2	push button	TA-3241-EP-LED (one located at 12" a.f.f.)	630
1	wall sign	TA-EXS-PCFA (UWR emergency signage)	
1	horn/strobe annunciator	CM-AF141SO (mount in corridor)	
1	horn/strobe annunciator	CM-AF501SO (assistance requested) (mount in washroom)	
1	integration box	TA-2909-PIK (screw on cover plate)	
1	integration module	TA-2880-12 x TA-2799	
1	power supply	BPS-24-2	
1	battery	SLA12-4.5(2) (24V)	
1	wiring diagram	refer to wiring elevation DE03	

Heading #4

1	sgle door	105	exterior from corridor 105	RHR

Type C 38" x 86" x 1-3/4" hm door / ps frame
6" x 32" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

1	mortar box	TA-6410 (to suit door contact location)	
3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	exit device	LD-8810J x 649 (rhr)	630
1	overhead stop	104S (concealed) (33-1/16"-39")	630
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (lh)	689
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	threshold	CT-45 x 42" x no holes	627
1	door sweep	W-38S x 38"	628
1	weatherstrip	W-50S x 17'6 (1@38", 2@86")	628
1	astragal	W-7 x 86" (rhr)	600
1	integration box/module	TA-2966 (DC)	
1	wiring diagram	refer to wiring elevation DE04	

Heading #5

1	sliding door	106	corridor 105 to small pet intake 106

Type G 44" x 84" x 1/2" sliding glass door

1		all hardware by sliding glass door supplier

Brantford Animal Shelter

Heading #6

1	sgle door	107	corridor 105 to cat adoption 107	LH

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

3	hinges	T4A3786 5" x 4"	652
1	door pull	CBH 7530B-1 c/w 1/8" x 2" x 15-1/2" plate #1	630
1	push plate	923 6" x 24" x B4E x ws/ss rivets	630
1	closer	4011 REG x mws (lh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628

Heading #7

1	sliding door	108	corridor 105 to cat group adoption 108

Type E 38" x 84" sliding glass door / aluminum frame

1	all hardware by sliding glass door supplier

Heading #8

1	sgle door	109A	lobby 102 to dog meet/greet 109	RH

Type B 38" x 84" x 1-3/4" aluminum door / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3786 5" x 4"	652
1	push / pull set	CBH 7004 x length to suit x #6, #3, #6 mounting (rh)	630
1	closer	4011 REG x mws (rh)	689
1	wall stop	CBH 140	630
1	weatherstrip	perimeter weatherstrip integral to frame stop	

Heading #9

1	sgle door	109B	dog meet/greet 109 from dog adoption 112	LHR

Type D 38" x 84" x 1-3/4" hm door / ps frame
slab door

3	hinges	T4A3786 5" x 4"	652
1	lockset	LC-8204 LNJ x 82-0110 (lhr)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	closer	4011 REG x mws (rh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628

Heading #10

1	sgle door	110	lobby 102 from corridor 110	RHR

Type B 38" x 84" x 1-3/4" aluminum door / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3786 5" x 4-1/2" NRP	652
1	electric strike	supplied/installed by others	
1	lockset	LC-8204 LNJ x 82-0110 (rhr)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (lh)	689
1	wall stop	CBH 140	630
1	reader	supplied/installed by others	
1		verify all electrical requirements with security system supplier	

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Heading #11

1	sgle door	111A	corridor 110 to food prep 111	LH

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

3	hinges	T4A3786 5" x 4"	652
1	door pull	CBH 7530B-1 c/w 1/8" x 2" x 15-1/2" plate #1	630
1	push plate	923 6" x 24" x B4E x ws/ss rivets	630
1	closer	4011 REG x mws (lh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630

Heading #12

1	sgle door	111B	dog adoption 112 from food prep 111	RHR

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

3	hinges	T4A3786 5" x 4"	652
1	passage set	8215 LNJ x 82-0110 (rhr)	630
1	closer	4011 REG x mws (lh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630

Heading #13

1	sgle door	112	exterior from dog adoption 112	RHR

Type A 38" x 84" x 2-1/4" insulclad aluminum doors / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	current transfer	CEPT-10	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	electric exit device	LC-55-56-8504J x 650F31-8 x 24V (rhr)	630
1	rim cylinder	34 (temporary for construction phase)	630
1	rim cylinder	permanent cylinder by locksmith - supplied/installed by 08710	
1	door pull	H49-1802 x 2-1/4" door (rhr)	652*
1	overhead stop	104S (concealed) (33-1/16"-39")	630
1	auto operator	LE4100 x 42" (push side mount) x 120V (rhr)	628
1	threshold	CT-45 x 42" x no holes	627
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628
1	door sweep	W-38S x 38"	628
1	reader	supplied/installed by others	
2	mounting box	4 x 4 edge	630
2	push button	CM-45/4 (push to open)	630
1	integration box	TA-2909-PIK (screw on cover plate)	
1	integration module	TA-2880-12 x TA-2673	
1	power supply	BPS-24-2	
1	battery	SLA12-4.5(2) (24V)	
1	wiring diagram	refer to wiring elevation DE05	

Heading #14

1	sgle door	113	corridor 110 from corridor 113	RHR

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

1	mortar box	TA-6410 (to suit auto operator location)	
3	hinges	T4A3786 5" x 4-1/2" NRP	652
1	door pull	CBH 7530B-1 c/w 1/8" x 2" x 15-1/2" plate #1	630
1	push plate	923 6" x 24" x B4E x ws/ss rivets (install covering thru bolts)	630
1	auto operator	7900 x 42" (push side mount) x 120V (rhr)	628
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
2	mounting box	4 x 4 edge	630
2	push button	CM-45/4 (push to open)	630
1	wiring diagram	refer to wiring elevation DE06	

Heading #15

1	sgle door	114A	corridor 113 to staff washroom 114	LH

Type D 38" x 84" x 1-3/4" hm door / ps frame
slab door

3	hinges	T4A3786 5" x 4"	652
1	privacy set	V21-8265 LNJ x 82-0110 (lh)	630
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630

Heading #16

1	sliding door	114B	staff washroom 114 to staff shower	

Type S shower unit

1	all hardware by sliding glass door supplier	

Heading #17

1	sgle door	116	staff room 115 from closet 116	RHR

Type D 36" x 84" x 1-3/4" hm door / ps frame
slab door

3	hinges	TA2714 4-1/2" x 4" NRP	652
1	passage set	8215 LNJ x 82-0110 (rhr)	630
1	mop plate	903 10" x 35" x B4E x ws/ss rivets	630

Heading #18

1	sgle door	119	admin 118 to file storage 119	RH

Type D 38" x 84" x 1-3/4" hm door / ps frame
slab door

3	hinges	TA2714 5" x 4"	652
1	lockset	LC-8237 LNJ x 82-0110 (rh)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630

Heading #19

1	sgle door	121	corridor 120 to office 121	RH

Type B 38" x 84" x 1-3/4" aluminum door / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	TA2714 5" x 4"	652
1	lockset	LC-8205 LNJ x 82-0110 (rh)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	wall stop	CBH 140	630

Heading #20

1	sgle door	122A	cat corridor 127 to mechanical 122	RH

Type D 38" x 84" x 1-3/4" hm door / ps frame 45 min
slab door

3	hinges	TA2714 5" x 4"	652
1	lockset	LC-8204 LNJ x 82-0110 (rh)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	closer	4011 REG x mws (rh)	689
1	floor stop	CBH 110	619
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets (mount above adb)	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628
1	auto door bottom	CT-52B x 38"	628

Heading #21

1	sgle door	122B	exterior from mechanical 122	LHR

Type D 48" x 84" x 1-3/4" hm door / ps frame
slab door

1	mortar box	TA-6410 (to suit door contact location)	
3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	lockset	LC-8204 LNJ x 82-0110 (lhr)	630
1	strike	2M-0110-SA (rh)	652
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	overhead holder	599H (39-1/4" +)	626
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (rh)	689
1	kick plate	903 10" x 46-1/2" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 18'0 (1@48", 2@84")	628
1	door sweep	W-38S x 48"	628
1	threshold	CT-45 x 60" x no holes	627
1	astragal	W-7 x 84"	600
1	integration box	TA-2909-CAB	
1	wiring diagram	refer to wiring elevation DE04	

Heading #22

1	sgle door	123	exterior from open office 123	RHR

Type A 38" x 84" x 2-1/4" insulclad aluminum doors / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	exit device	55-56-8510J x 650F31-8 x 24V (rhr)	
1	overhead stop	104S (concealed) (33-1/16"-39")	630
1	auto operator	LE4100 x 42" (push side mount) x 120V (rhr)	628
1	threshold	CT-45 x 42" x no holes	627
1	door sweep	W-38S x 38"	628
1	weatherstrip	perimeter weatherstrip integral to frame stop	
1	mounting box	4 x 4 edge (interior only)	630
1	push button	CM-45/4 (push to open) (interior only)	630
1	integration box	TA-2909-PIK (screw on cover plate)	
1	integration module	TA-2880-12 x TA-2673	
1	power supply	BPS-24-2	
1	battery	SLA12-4.5(2) (24V)	
1	wiring diagram	refer to wiring elevation DE07	
1		exit only no outside access	

Heading #23

1	pair doors	124	open office 123 from closet 124	LHR/RHR

Type D 2 @ 34" x 84" x 1-3/4" hm doors / ps frame
slab doors

6	hinges	TA2714 4-1/2" x 4" NRP	652
2	roller latch	GSH 1	626
2	door pull	CBH 7530B-1 c/w 1/8" x 2" x 15-1/2" plate #1	630

Brantford Animal Shelter

Heading #24

1	sgle door	125A	corridor 110 to cat intake 125	RH

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

1	mortar box	TA-6410 (to suit electric strike location)	
3	hinges	T4A3786 5" x 4"	652
1	electric strike	1006CLB x 24V	630
1	passage set	8215 LNJ x 82-0110 (rh)	630
1	overhead stop	598S (32-5/8"-39-1/8")	626
1	auto operator	7900 x 42" x parallel arm (pull side mount) x 120V (rh)	628
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628
2	mounting box	4 x 4 edge	630
2	push button	CM-45/4 (push to open)	630
1	relay	CX-12+ interface relay (mount in AO header)	
1	converter	PYBE30-Q24-S24 (24V) (mount in AO header)	
1	wiring diagram	refer to wiring elevation DE08	
1		all terminations completed in A/O header	

Heading #25

1	sgle door	125B	cat corridor 127 from cat intake 125	LHR

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

3	hinges	T4A3786 5" x 4-1/2" NRP	652
1	passage set	8215 LNJ x 82-0110 (lhr)	630
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (rh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628

Heading #26

1	sgle door	126	cat intake 125 to cat nursing 126	RH

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

3	hinges	TA2714 5" x 4"	652
1	passage set	8215 LNJ x 82-0110 (rh)	630
1	closer	4011 REG x mws (rh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628

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Heading #27

1	sgle door	127	exterior from cat corridor 127	LHR

Type A 38" x 84" x 2-1/4" insulclad aluminum doors / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	current transfer	CEPT-10	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	electric exit device	LC-55-56-8504J x 650F31-8 x 24V (lhr)	630
1	rim cylinder	34 (temporary for construction phase)	630
1	rim cylinder	permanent cylinder by locksmith - supplied/installed by 08710	
1	door pull	H49-1802 x 2-1/4" door (lhr)	652*
1	overhead stop	104S (concealed) (33-1/16"-39")	630
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (rh)	689
1	threshold	CT-45 x 42" x no holes	627
1	door sweep	W-38S x 38"	628
1	weatherstrip	perimeter weatherstrip integral to frame stop	
1	reader	supplied/installed by others	
1	integration box	TA-2909-PIK (screw on cover plate)	
1	integration module	TA-2880-12	
1	power supply	BPS-24-2	
1	battery	SLA12-4.5(2) (24V)	
1	wiring diagram	refer to wiring elevation DE05	

Heading #28

1	pair doors	127B	cat corridor from electrical closet	RHRA

Type D 2 @ 27" x 84" x 1-3/4" hm doors / ps frame
slab door

6	hinges	TA2714 4-1/2" x 4" NRP	652
1	flush bolt	FB458 x 12"	626
1	lockset	LC-8237 LNJ x 82-0110 (rhr)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
2	overhead stop	597S (24"-32-1/2")	626
2	mop plate	903 10" x 26" x B4E x ws/ss rivets	630
1	astragal	W-7 x 84" (mount push side of inactive door)	600

Heading #29

1	sgle door	128	cat corridor 127 to cat isolation 128	LH

Type B 38" x 84" x 1-3/4" aluminum door / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	TA2714 5" x 4"	652
1	passage set	8215 LNJ x 82-0110 (lh)	630
1	overhead stop	598S (32-5/8"-39-1/8")	626
1	closer	4011 REG x mws (lh)	689
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628

Heading #30

1	sgle door	129	cat corridor 127 to loading bay storage 129	LH

Type D 38" x 84" x 1-3/4" hm door / ps frame
slab door

3	hinges	T4A3786 5" x 4"	652
1	passage set	8215 LNJ x 82-0110 (lh)	630
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630

Heading #31

1	sgle door	130A	receiving bay 130 from loading bay storage 129	LHR

Type D 38" x 84" x 1-3/4" hm door / ps frame 45 min
slab door

3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	passage set	8215 LNJ x 82-0110 (lhr)	630
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (rh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628

Heading #32

1	overhead door	130B	exterior from receiving bay 130

Type F 12'4" x 9'4" overhead door

1	all hardware by overhead door supplier

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Heading #33

1	sgle door	130C	receiving bay 130 from corridor 134	RHR
Type D slab door	38" x 84" x 1-3/4"	hm door / ps frame		45 min

1	mortar box	TA-6410 (to suit auto operator location)	
1	mortar box	TA-6410 (to suit electric strike location)	
3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	electric strike	1006CLB x 24V	630
1	passage set	8215 LNJ x 82-0110 (rhr)	630
1	auto operator	7900 x 42" x parallel arm (pull side mount) x 120V (lh)	628
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	threshold	CT-45 x 42" x no holes	627
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628
1	door sweep	W-38S x 38"	628
2	mounting box	4 x 4 edge	630
2	push button	CM-45/4 (push to open)	630
1	relay	CX-12+ interface relay	
1	converter	PYBE30-Q24-S24 (24V)	
1	wiring diagram	refer to wiring elevation DE09	
1		all terminations completed in A/O header	

Heading #34

1	sgle door	130D	exterior from receiving bay 130	LHR

Type C 38" x 86" x 1-3/4" hm door / ps frame
6" x 32" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

1	mortar box	TA-6410 (to suit current transfer location)	
1	mortar box	TA-6410 (to suit door contact location)	
3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	current transfer	CEPT-10	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	electric exit device	LC-55-56-8504J x 650F31-8 x 24V (lhr)	630
1	rim cylinder	34 (temporary for construction phase)	630
1	rim cylinder	permanent cylinder by locksmith - supplied/installed by 08710	
1	door pull	H49-1802 x 2-1/4" door (lhr)	652*
1	overhead stop	104S (concealed) (33-1/16"-39")	630
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (rh)	689
1	threshold	CT-45 x 42" x no holes	627
1	door sweep	W-38S x 38"	628
1	weatherstrip	W-50S x 17'6 (1@38", 2@86")	628
1	astragal	W-7 x 86" (lhr)	600
1	reader	supplied/installed by others	
1	integration box	TA-2909-PIK (screw on cover plate)	
1	integration module	TA-2880-12	
1	power supply	BPS-24-2	
1	battery	SLA12-4.5(2) (24V)	
1	wiring diagram	refer to wiring elevation DE05	

Heading #35

1	sgle door	131	exterior from wildlife room 131	RHR

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

1	mortar box	TA-6410 (to suit door contact location)	
1	mortar box	TA-6410 (to suit electric strike location)	
3	hinges	TA2314 5" x 4" NRP	630
1	electric strike	supplied/installed by others	
1	lockset	LC-8204 LNJ x 82-0110 (rhr)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (lh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	threshold	CT-45 x 42" x no holes	627
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628
1	door sweep	W-38S x 38"	628
1	astragal	W-7 x 84"	600
1	reader	supplied/installed by others	
1		verify all electrical requirements with security system supplier	

Heading #36

1	sgle door	132	corridor 134 to laundry 132	LH

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

3	hinges	TA2714 5" x 4"	652
1	passage set	8215 LNJ x 82-0110 (lh)	630
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630

Heading #37

1	sgle door	133	corridor 134 to janitor 133	RH
Type D slab door	38" x 84" x 1-3/4"	hm door / ps frame		45 min
3	hinges	TA2714 5" x 4"		652
1	passage set	8215 LNJ x 82-0110 (rh)		630
1	closer	4011 DEL REG x mws (rh)		689
1	wall stop	CBH 140		630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets		630

Heading #38

1	sgle door	134	exterior from corridor 134	LHR

Type C 38" x 84" x 1-3/4" hm door / ps frame
6" x 30" upper lite - 8" top rail and stiles
6" x 24" lower lite - 10" mid rail, 12" bottom rail

1	mortar box	TA-6410 (to suit current transfer location)	
1	mortar box	TA-6410 (to suit door contact location)	
3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	current transfer	CEPT-10	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	electric exit device	LC-55-56-8504J x 650F31-8 x 24V (lhr)	630
1	rim cylinder	34 (temporary for construction phase)	630
1	rim cylinder	permanent cylinder by locksmith - supplied/installed by 08710	
1	door pull	H49-1802 x 2-1/4" door (lhr)	652*
1	overhead stop	104S (concealed) (33-1/16"-39")	630
1	adapter plate	4020-18G x mws	689
1	closer	4021 LONG x mws (rh)	689
1	threshold	CT-45 x 42" x no holes	627
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628
1	door sweep	W-38S x 38"	628
1	reader	supplied/installed by others	
1	integration box	TA-2909-PIK (screw on cover plate)	
1	integration module	TA-2880-12	
1	power supply	BPS-24-2	
1	battery	SLA12-4.5(2) (24V)	
1	wiring diagram	refer to wiring elevation DE05	

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Heading #39

1	sgle door	135A	exterior from dog intake 135	LHR

Type A 38" x 84" x 2-1/4" insulclad aluminum doors / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3386 5" x 4-1/2" NRP	630
1	current transfer	CEPT-10	630
1	door contact (concealed)	PFC42WY (concealed) (DPDT x 3/4" Ø)	BLK
1	electric exit device	LC-55-56-8504J x 650F31-8 x 24V (lhr)	630
1	rim cylinder	34 (temporary for construction phase)	630
1	rim cylinder	permanent cylinder by locksmith - supplied/installed by 08710	
1	door pull	H49-1802 x 2-1/4" door (lhr)	652*
1	overhead stop	104S (concealed) (33-1/16"-39")	630
1	auto operator	LE4100 x 42" (push side mount) x 120V (lhr)	628
1	threshold	CT-45 x 42" x no holes	627
1	door sweep	W-38S x 38"	628
1	weatherstrip	perimeter weatherstrip integral to frame stop	
1	reader	supplied/installed by others	
2	mounting box	4 x 4 edge	630
2	push button	CM-45/4 (push to open)	630
1	integration box	TA-2909-PIK (screw on cover plate)	
1	integration module	TA-2880-12 x TA-2673	
1	power supply	BPS-24-2	
1	battery	SLA12-4.5(2) (24V)	
1	wiring diagram	refer to wiring elevation DE05	

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Heading #40

1	sgle door	135B	corridor 135 to dog intake 135	LH

Type B 38" x 84" x 1-3/4" aluminum door / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3786 5" x 4"	652
1	passage set	8215 LNJ x 82-0110 (lh)	630
1	overhead stop	598S (32-5/8"-39-1/8")	626
1	closer	4011 REG x mws (lh)	689

Heading #41

1	sgle door	135C	corridor 134 to dog intake 135	RH

Type B 38" x 84" x 1-3/4" aluminum door / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3786 5" x 4"	652
1	passage set	8215 LNJ x 82-0110 (rh)	630
1	closer	4011 REG x mws (rh)	689
1	wall stop	CBH 140	630

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Heading #42

1	sgle door	136	corridor 134 to dog isolation 136	RH

Type D 38" x 84" x 1-3/4" hm door / ps frame
slab door

3	hinges	T4A3786 5" x 4"	652
1	lockset	LC-8237 LNJ x 82-0110 (rh)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	closer	4011 REG x mws (rh)	689
1	wall stop	CBH 140	630
1	kick plate	903 10" x 36-1/2" x B4E x ws/ss rivets	630
1	mop plate	903 10" x 37" x B4E x ws/ss rivets	630
1	weatherstrip	W-50S x 17'2 (1@38", 2@84")	628

Heading #43

1	sgle door	137	corridor 134 to exam room 135	RH

Type B 38" x 84" x 1-3/4" aluminum door / aluminum screen
28" x 35" upper lite - 5" top rail and stiles
28" x 29" lower lite - 8-1/2" mid rail, 6-1/2" bottom rail

3	hinges	T4A3786 5" x 4"	652
1	electric strike	supplied/installed by others	
1	lockset	LC-8204 LNJ x 82-0110 (rh)	630
1	mortise cylinder	41 (temporary for construction phase)	630
1	mortise cylinder	permanent cylinder by locksmith - supplied/installed 08710	
1	closer	4011 REG x mws (rh)	689
1	wall stop	CBH 140	630
1	reader	supplied/installed by others	
1		verify all electrical requirements with security system supplier	

1.1 RELATED REQUIREMENTS

.1 Rough Carpentry: Section 06 10 00
.2 Sectional Metal Doors: Section 08 36 13
.3 Division 26 - Electrical

1.2 REFERENCES

.1 National Electrical Manufacturers Association (NEMA): NEMA ICS 6 - Industrial Control and Systems: Enclosures.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for Operators and accessories:
    .1 Preparation instructions and recommendations.
    .2 Storage and handling requirements and recommendations.
    .3 Installation methods.
    .4 Cleaning Methods

.3 Shop Drawings:

  .1 Submit shop drawings showing layout, profiles, and product components, including anchorage, edge conditions, and accessories.

.4 Manufacturers Reports:

  .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Procedures & Submittals.
.2 Operation and Maintenance Data: submit operation and maintenance data for Overhead Door Operators for incorporation into manual.

1.5 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.
.3 Storage and Handling Requirements:
  .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect sectional metal doors, hardware and accessories from [nicks, scratches, and blemishes].
  .3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials.

1.6 WARRANTY

.1 Overhead Door Operator Warranty: Manufacturer’s standard limited 2-year warranty against material and manufacturing defects.

Part 2 Products

2.1 HOIST TYPE DOOR OPERATORS

.1 Heavy-Duty Operator: 4 required, high-starting torque motor with overload protection and emergency chain hoist with electric interlock.

.1 Electric Operator: Heavy-duty assembly, cULus listed and cULus labeled, with electric motor and factory-prewired motor controls, emergency floor-level manual chain hoist mechanism with electrical interlock, electric solenoid-actuated brake, 3-button open/close/stop control station, conduit-encased wiring from control circuit to motor, and accessories required for proper operation; operator shall provide a door speed of approximately 8 to 9 inches (203 to 229 mm) per second.

.2 Primary Speed Reduction: Heavy-duty 4L V-belt and #41 chain and sprocket with sprocket reduced secondary; operator shall be equipped with adjustable friction clutch and output and door driven sprockets.

.3 Brake: Electric solenoid-actuated brake capable of stopping and holding a door at any position.

.4 Limit Switches: Fully adjustable, linear-driven limit mechanism synchronizing operator with door; low-friction nylon limit nuts fitted on threaded steel shaft that rotates on oil-tight self-lubricating bronze bushings; motor shall be removable without affecting limit switch settings.

.5 Electric Motor: High-starting torque, 115V, single-phase, 1/2 HP motor with an internal automatic reset thermal overload device to protect against overload.

.6 Motor Control and Enclosure: LiftMaster (or approved alternate) heavy-duty Logic motor control shall be a microprocessor solid-state type PCB; the control board shall provide the capability to select one of 2 wiring types, diagnostic LEDs for operator status and troubleshooting, programmable Timer-to-Close with timer defeat capabilities and a maximum run timer to provide motor overrun protection; motor control shall be housed in a NEMA 1 enclosure integral to the operator and shall conform to ANSI/NEMA ICS 6.

.7 Radio Receiver: LiftMaster (or approved alternate) heavy-duty Logic on-board, 3-channel receiver external antenna; equipped to accept Security+ Rolling Code Technology remote controls and trinary DIP switch remote controls, with memory for up to 20 Security+ remote controls or an unlimited number of trinary DIP switch remote controls.

.8 3-Button Control Station: 3-button station providing open/close/stop within a NEMA 1 Type enclosure.

.9 Door Drive: Full #41 roller chain; operator shall be equipped with an electrically interlocked, floor level disconnect and chain hoist for manual operation.

.10 Primary Entrapment Protection Devices:

.1 NEMA 1 Monitored Photo Sensors: LiftMaster (or approved alternate) CPS-U Monitored Photo Eyes fully monitored, non-contact, infrared beam photo sensor system shall reverse, in conjunction with the medium-duty Logic operator, a closing door to the full open position when an obstruction is sensed; photo sensors shall be mounted no higher than 6 inches (152 mm) maximum above the floor.

.11 Acceptable Product:

.1 Liftmaster RBH Heavy Duty

.2 or approved alternate

.11 Universal Remote Controls: 4 button

.1 Lift Master 894 LM

.2 6 remotes required

.3 or approved alternate

Part 3 EXECUTION

3.1 EXAMINATION

.1 Do not begin installation until openings have been properly prepared.
.2 Verify electric power is available and of correct characteristics.

3.2 PREPARATION

.1 Clean surfaces thoroughly prior to installation.
.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

.1 Install overhead doors operators in accordance with approved shop drawings and the manufacturer's printed instructions.
.2 Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
.3 Anchor operators to wall construction and building framing without distortion or stress.
.4 Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.
.5 Instruct Owner’s personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

.1 Test for proper operation and adjust as necessary to provide proper operation without binding or distortion
.2 Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

.1 Clean doors, frames and glass using non-abrasive materials and methods recommended by manufacturer.
.2 Remove labels and visible markings.
.3 Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

.1 Do not permit construction traffic through overhead door openings after adjustment and cleaning.
.2 Protect installed products until completion of project.

3.7 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product within 3 days of review.
.2 Submit 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 at stages listed:

.1 Upon completion of Work in this section, after cleaning is carried out.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Metal Doors & Frames: Section 08 11 00
.2 Aluminum Window Framing: Section 08 11 16
.3 Aluminum Doors: Section 08 11 17

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB).
  .1 CAN/CGSB-12.8-97, Insulating Glass Units.
  .2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.

1.3 PERFORMANCE REQUIREMENTS

.1 General Performance: Comply with performance requirements specified, as determined by testing of glass systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  .1 Glazed canopy shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads. Failure also includes the following:
    .1 Thermal stresses transferring to building structure.
    .2 Loosening or weakening of fasteners, attachments, and other components.
.2 Delegated Design: Design canopy glass, including comprehensive engineering analysis by a qualified professional engineer in the Province of Ontario, using performance requirements and design criteria according to Ontario Building Code.
.3 Wind loads: Provide canopy glass system; include anchorage, capable of withstanding wind load design pressures in accordance with Ontario Building Code.

1.4 SUBMITTALS – PRODUCT DATA

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.

1.6 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual specified in Section 01 78 00 – Closeout Procedures & Submittals.
.2 Provide two of Standoff System Manufacturer’s standard Stand-off Wrenches as part of Maintenance Materials.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Protection:
  .1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Do not use coatings that shall become hard to remove or leave residue.
  .2 Leave protective covering in place until final cleaning of building.

Part 2 Products

2.1 MATERIALS

.1 Glazing:

.1 Tempered Glass: to CAN/CGSB-12.1, transparent, thickness as indicated on drawings, clear.

.1 Type 2-tempered.

.2 Class B-float.

.3 Exposed Panel Edge Type: Flat

.4 Exposed Panel Edge Finish: Polished

.2 Float glass: to CAN/CGSB-12.3, glazing quality, ¼" thickness unless indicated otherwise, clear.

.2 Insulated glass units: to CAN/CGSB-12.8, double glazed with outer pane of ¼" (6 mm) thick Solarban 70XL Low E Glazing, or guardian Glass SNX 62/27 and inner pane of ¼" (6 mm) thick tempered glass. Provide argon gas filled inter-cavity space with thickness of ½" (13 mm); overall total thickness 1" (25 mm).

.3 Spandrel Glass Units: Outer Pane: 6 mm (+/-), to CAN/CGSB 12.9-M91 with type 1 tempered, to CAN/CGSB 12.1-M90, Category II coloured scrim on second surface (to be selected by consultant); 540 J impact resistance, inner pane of 6 mm thick clear float glass and argon gas filled inter-cavity space with thickness of 13 mm; overall total thickness 25 mm.

.4 Mirrors: 6mm thickness, silvered to give maximum reflection, free from tarnishing, discolouration, scratches and other defects in the designed viewing conditions.

2.2 ACCESSORIES

.1 Sealant compound: silicone sealant to glass manufacturer's recommendations. Submit colour to Consultant for approval.

.2 Glazing tape:

.1 For Units up to 75 United Inches: preformed butyl tape, 10-15 durometer hardness, paper release.

.2 For units in excess of 75 United Inches: extruded tape with integral spacer shim.

.3 Setting blocks and spacer shims: neoprene, Shore "A" durometer hardness 80-90, size and location to manufacturer's recommendations.

.4 Primer-sealers and cleansers: to glass manufacturer's standard.

.5 Glazing Film; based on 3m Products, or approved alternate

.1 Frosted Film, to withstand UV Rays without effecting glass performance. Refer to Drawings for locations.

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 GLAZING PREPARATION

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 GLAZING INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)

.1 Perform work in accordance with GANA Glazing Manual for glazing installation methods.

.2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.

.3 Place setting blocks at 1/3 points, with edge block maximum 6" (150 mm) from corners.

.4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
.5 Place glazing tape on free perimeter of glazing in same manner described.
.6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
.7 Knife trim protruding tape.

2.5 CLEANING

.1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
.2 Clean glass and glazing materials with approved non-abrasive cleaner.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 21 16: Blanket Insulation
.2 Section 09 22 16: Non-Structural Metal Framing
.3 Section 09 90 00: Painting

1.2 REFERENCES

.1 ASTM International
  .1 ASTM C475-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  .2 ASTM C840-08, Standard Specification for Application and Finishing of Gypsum Board.
  .3 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  .4 ASTM C1280-99, Standard Specification for Application of Gypsum Sheathing.
  .5 ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.
.2 Underwriters' Laboratories of Canada (ULC)
  .1 CAN/ULC-S102-07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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.
.3 Storage and Handling Requirements:
  .1 Store gypsum board assemblies materials level in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
  .3 Protect from weather, elements and damage from construction operations.
  .4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
  .5 Replace defective or damaged materials with new.
.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials.

1.5 AMBIENT CONDITIONS

.1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum 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 MATERIALS

.1 Standard board: to ASTM C1396/C1396M regular, 5/8" (16 mm) thick, Type X, thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.

.2 Glass mat water-resistant gypsum backing board: to ASTM C1178/C1178M, thickness as indicated, 4'-0" (1200 mm) wide x maximum practical length.

.3 Glass-mat liner panel, thickness to achieve noted fire rated separation.

.4 Metal furring runners, hangers, tie wires, inserts, anchors: manufacturer's standard.

.5 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.6 Steel drill screws: to ASTM C1002.

.7 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.8 Architectural Reveal Bead (Tapeable metal reveal): ½" wide by ½" deep rectangular reveal, Product: Trim-tex Drywall Products, Stock Number AS5110 or approved alternate.

.9 Sealants: in accordance with Section 07 90 00 - Joint Sealants.

.1 Acoustic sealant: in accordance with Section 07 90 00 - Joint Sealing.

.10 Insulating strip: rubberized, moisture resistant, 1/8" (3 mm) thick cork or closed cell neoprene strip, ½" (12 mm) wide, with self-sticking permanent adhesive on one face, lengths as required.

.11 Joint compound: to ASTM C475, asbestos-free.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies' installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant, inform Consultant of unacceptable conditions immediately upon discovery. Beginning installations means acceptance of existing conditions.

3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.

.2 Do application of gypsum sheathing to ASTM C1280.

.3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.

.4 Support light fixtures by providing additional ceiling suspension hangers within 6" (150 mm) of each corner and at maximum 24" (600 mm) around perimeter of fixture.

.5 Install work level to tolerance of 1:1200.

.6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.

.7 Install ¾" X 2 ½" (19 x 64 mm) furring channels parallel to, and at exact locations of steel stud partition header track.

.8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.10 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.

.11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Check clearances with equipment suppliers.

.12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.3 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.

.2 Apply single layer gypsum board to metal furring or framing using screw fasteners Maximum spacing of screws 12" (300 mm) on centre].

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that shall minimize end joints.

.3 Apply water-resistant gypsum board where indicated. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.

.4 Apply Tile Backer Board where indicated in accordance with manufacturer's instructions.

.5 Apply ½' (12 mm) diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

.6 Install ceiling boards in direction that shall minimize number of end-butt joints. Stagger end joints at least 10" (250 mm).

.7 Install gypsum board on walls vertically to avoid end-butt joints.

.8 Install gypsum board with face side out.

.9 Do not install damaged or damp boards.

.10 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

.1 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 in accordance with manufacturer's instructions.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Construct control joints of two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint.

.6 Provide continuous polyethylene dust barrier behind and across control joints.

.7 Locate control joints at changes in substrate construction or at approximate 30'-0" (10 m) spacing on long corridor runs and at approximate 45'-0" (15 m) spacing on ceilings].

.8 Install control joints straight and true.

.9 Install expansion joint straight and true.

.10 Splice corners and intersections together and secure to each member with 3 screws.

.11 Install access doors to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

.12 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.13 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 Level 4: 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.

.14 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.15 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.16 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.17 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon substantial completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management: separate waste materials for reuse or recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 21 16: Blanket Insulation
.2 Section 09 21 16 Gypsum Board Assemblies.
.3 Section 09 90 00 Painting.

1.2 REFERENCES

.1 ASTM International
  .1 ASTM C645-11a, Standard Specification for Non-structural Steel Framing Members.
  .2 ASTM C754-11, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
.2 Certificates: submit 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, store and handle materials in accordance 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.
.3 Storage and Handling Requirements:
  .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect metal framing from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.
.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials.

Part 2 Products

2.1 MATERIALS

.1 Non-load bearing channel stud framing: to ASTM C645, stud size as indicated, roll formed from 26 ga (0.45 mm) thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board.
  .1 Knock-out service holes at 18” (460 mm) centres.
.2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 1¼” (32 mm) flange height.
.3 Metal channel stiffener: cold rolled steel, coated with rust inhibitive coating.
.4 Acoustical sealant: in accordance with Section 07 92 00 - Joint Sealants.
.5 Insulating strip: rubberized, moisture resistant 1/8” (3 mm) thick cork or foam strip, ½” (12 mm) wide, with self sticking adhesive on one face, lengths as required.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for non-structural metal framing application in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant, Inform Consultant of unacceptable conditions immediately upon discovery, Beginning work means acceptance of conditions.

3.2 ERECTION

.1 Align partition tracks at floor and ceiling and secure at 24” (600 mm) on centre maximum.

.2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.

.3 Place studs vertically at 16” (400 mm) on centre and not more than 2” (50 mm) from abutting walls, and at each side of openings and corners.

.1 Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.4 Erect metal studding to tolerance of 1:1000.

.5 Attach studs to bottom and ceiling track using screws.

.6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

.8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified.

.1 Secure studs together, 2” (50 mm) apart using column clips or other approved means of fastening placed alongside frame anchor clips.

.9 Install heavy gauge single jamb studs at openings.

.10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs.

.1 Secure track to studs at each end, in accordance with manufacturer's instructions.

.2 Install intermediate studs above and below openings in same manner and spacing as wall studs.

.11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.12 Provide 1 5/8” (40 mm) stud or furring channel 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.

.13 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.14 Extend partitions to ceiling height except where noted otherwise on drawings.

.15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.

.16 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.17 Install two continuous beads of acoustical sealant or insulating strip under studs and tracks around perimeter of sound control partitions.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion of this section remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management: separate waste materials for reuse or recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies' installation at no additional cost to Owner.

End Of Section

Part 1 General

1.1 REFERENCES

.1 Terrazzo Tile and Marble Association of Canada (TTMAC)
.1 Tile Installation Manual 09 30 00 2012-2014, Tile Installation Manual.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
.1 Include manufacturer's information on:
.1 Porcelain tile, marked to show each type, size, and shape required.
.2 Chemical resistant mortar and grout
.3 Dry-set cement mortar and grout.
.4 Divider strip.
.5 Waterproofing isolation membrane.
.6 Fasteners.
.3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
.1 Floor & Wall tile: submit colour, texture, size, and pattern of each tile.
.2 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.

1.3 QUALITY ASSURANCE

.1 Quality Assurance Submittals:
.1 Manufacturer's Instructions: manufacturer's installation instructions.
.2 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 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 Waste Management and Disposal: Separate waste materials for recycling.

1.5 AMBIENT CONDITIONS

.1 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 degrees C for 48 hours before, during, and 48 hours after, installation.
.2 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.

1.6 MAINTENANCE

.1 Extra Materials:
.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals
.2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
.3 Maintenance material shall be same production run as installed material.

Part 2 Products

2.1 FLOOR TILE

.1 Porcelain tile (FF1): Acceptable Product:
.1 Urbancrete (12" x 24") Colour: Mink by Centura.
.2 or approved alternate
.2 Porcelain tile (FF6): Acceptable Product:
.1 Cellar (8” x 36") colour: Tone by Centura.
.2 or approved alternate
.3 Porcelain tile (FF7): Acceptable Product:
.1 Urbancrete (6" x 24") Colour: Mink by Centura.
.2 or approved alternate

2.2 WALL BASE

.1 Porcelain tile (WB1): Acceptable Product:
- .1 4" Porcelain Tile – Urbancrete – Mink by Centura.
- .2 or approved alternate

.2 Porcelain tile (WB3): Acceptable Product:
- .1 4" Porcelain Tile – Cellar – Tone by Centura.
- .2 or approved alternate

2.3 WALL TILE

.1 Porcelain tile (WF3): Acceptable Product:
- .1 Urbancrete (12" x 24") Mink by Centura.
- .2 or approved alternate

2.4 MORTAR, GROUT AND ADHESIVE MATERIALS

.1 Thin Set Adhesive: as recommended by tile manufacturer.

.2 Grout: Ultimate 6 Plus by Tec or approved alternate; Colours selected by Owner.

.3 Mortar Mixes: dry set mortar and organic adhesive mix to tile manufacturer's recommendations. 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.

2.5 ACCESSORIES

.1 Transition Strips: purpose made metal extrusion; stainless steel type.

.2 Reducer Strips: purpose made metal extrusion; stainless steel type; maximum slope of 1:2.

.3 Floor sealer and protective coating: to tile and grout manufacturers recommendations.

.4 Wall Finishing and Edge Protection:

1. L-shaped profile with 1/8" (3.2 mm) wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
2. Anchoring Leg: straight
3. Length: supply in maximum practical lengths, with minimum number of joints in final installation.
4. Height: to suit installation.
5. Acceptable product:
   - .1 Outside Corners: Schluter Finec, finish AE Satin Anodized, or approved alternate
   - .2 Inside Corners: Schluter Schluter-Dilex-HKU, finish AE Satin Anodized, or approved alternate

.5 Waterproofing Membrane and Accessories

1. 0.008" (8 mil) thick, orange polyethylene membrane, with polypropylene fleece laminated on both sides. Provide premanufactured components and corners as required to complete installation. Acceptable Product: Schluter Kerdi or approved alternate.
2. Waterproofing seaming membrane: 0.004" (4 mil) thick, orange polyethylene mebrame with polypropylene fleece laminated on both sides. Acceptable product Schluter Kerdi Band Seams & Corners or approved alternate.
3. Waterproofing Accessories:
   - .1 Schluter Kerd-Seal Mixing Valve Seals or approved alternate.
   - .2 Schluter Kerd Seal Pipe Seals or approved alternate.
   - .3 other components as recommended by manufacturer to complete installation.

.6 Shower Drains and Accessories:
- .1 Drain: as per Division 20 specifications.

2.6 PATCHING AND LEVELLING COMPOUND

.1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.

.2 Capable of being applied in layers up to 50 mm thick, being brought to feather edge, and being trowelled to smooth finish.

.3 Ready for use in 48 hours after application.

2.7 CLEANING COMPOUNDS

.1 Specifically designed for cleaning masonry and concrete and which shall 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.

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 WORKMANSHIP

.1 Do tile work in accordance with TTMAC Tile Installation Manual 2012/2014, "Tile Installation Manual", except where specified otherwise.

.2 Apply tile to clean and sound surfaces.

.3 Fit tile around corners, fitments, fixtures, and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.

.4 Maximum surface tolerance 1:800.

.5 Make joints between tile 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.

.6 Lay out tiles so perimeter tiles are minimum 1/2 size.

.7 Sound tiles after setting and replace hollow-sounding units to obtain full bond.

.8 Make internal angles square, external angles rounded.

.9 Install divider strips at junction of tile flooring and dissimilar materials.

.10 Clean installed tile surfaces after installation and grouting cured.

3.3 WALL TILE

.1 Install in accordance with TTMAC detail 304W 2012-2014.

3.4 FLOOR TILE

.1 Install in accordance with TTMAC detail 311F 2012-2014.

3.5 FLOOR SEALER AND PROTECTIVE COATING

.1 Apply in accordance with manufacturer's instructions.

3.6 FIELD QUALITY CONTROL

.1 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.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

End Of Section

Part 1 General

1.1 RELATED SECTIONS

.1 Submittal Procedures: Section 01 33 00

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM C635-00, Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- .2 ASTM C636-96, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- .3 ASTM E1477-98a(2003), 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 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-2003, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Submit duplicate samples of acoustical units.

.2 Submit ceiling grid manufacturer's certification that grid shall support super-imposed loads, such as lighting fixtures diffusers, grilles and speakers.

1.4 DESIGN REQUIREMENTS

.1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

1.5 STORAGE AND HANDLING

.1 Store materials inside, level, under cover. Protect from weather, damage from construction operations and other causes, in accordance with manufacturer's printed instructions.

.2 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.

Part 2 Products

2.1 ACOUSTICAL CEILING PANELS

.1 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1.
- .1 CF2: 24" x 24" x 1" nominal thick, Square
  - .1 CGC Radar
  - .2 or approved alternate.

2.2 ACOUSTICAL SUSPENSION

.1 Intermediate duty system to ASTM C635.

.2 Basic materials for suspension system: commercial quality cold rolled steel, zinc coated.

.3 Suspension system: non fire rated, two directional exposed tee bar grid.

.4 Exposed tee bar grid components: shop painted satin sheen. Components die cut. Main tee with double web, rectangular bulb and nominal 1" (25 mm) rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.
- .1 Grid Colour for all areas: White

.5 Hanger wire: galvanized soft annealed steel wire, 3.6 mm diameter for access tile ceilings.

.6 Hanger inserts: purpose made.

.7 Carrying channels: manufacturer's standard

.8 Accessories: splices, clips, wire ties, retainers and wall moulding flush, to complement suspension system components, as recommended by system manufacturer.

.9 Acceptable Products:
.1 Grid: USG Donn Brand DX/DXL 15/16" or approved alternate.

Part 3 Execution

3.1 INSTALLATION OF SUSPENSION SYSTEM

.1 Installation: in accordance with ASTM C636 except where specified otherwise.
.2 Do not erect ceiling suspension system until work above ceiling has been inspected by Consultant.
.3 Secure hangers to overhead structure using attachment methods acceptable to Consultant.
.4 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
.5 Lay out centreline of ceiling both ways, according to reflected ceiling plan.
.6 Install wall moulding to provide correct ceiling height.
.7 Completed suspension system to support super-imposed loads, such as lighting fixtures diffusers, grilles and speakers.
.8 Support at light fixtures, diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
.9 Interlock cross member to main runner to provide rigid assembly.
.10 Finished ceiling system to be square with adjoining walls and level within 1:1000.

3.2 INSTALLATION OF ACOUSTIC PANELS

.1 Install acoustical panels and tiles in ceiling suspension system.
.2 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.
.3 Paint exposed edge of cut tiles.

End of section

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM F1303-[04], Standard Specification for Sheet Vinyl Floor Covering with Backing.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

1.2 SUBMITTALS

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Submit samples of each type of flooring type.
- .2 Submit base samples.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Sections 01 33 00 - Submittal Procedures.

1.3 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Procedures & Submittals
- .2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
- .3 Maintenance material shall be same production run as installed material.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for resilient flooring for incorporation into manual specified in Section 01 78 00 - Closeout Procedures & Submittals.

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Provide a high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to the outside. Do not let contaminated air recirculate through a district or whole building air distribution system.

Part 2 Products

2.1 RESILIENT TILE FLOORING MATERIALS

.1 Resilient Sheet Vinyl Flooring (FF2): Noncushioned homogeneous sheet vinyl (non-asbestos) PVC with polyurethane (PUR) reinforced surface which requires no sealers, dressings, waxes or polishes, 2 mm thick, heat welded seams, colour and pattern dispersed uniformly throughout full thickness of product, roll width 2 m, maintenance requirement to be dry buff (no polish treatment, no sealers, waxes, or spray buff solution).
- .1 Acceptable Product:
  - .1 Sphere Element by Centura, Colour Clay #50019
  - .2 or approved alternate.

.2 Vinyl composition tile: to ASTM F1066, Composition 1 - non asbestos Class 3 – colour through, plain, 1/8” x 12” x 12” (3 x 300 x 300 mm) size
- .1 Acceptable Product:
  - .1 VCT II by Tarkett, Colour: Sandstone #556
  - .2 or approved alternate.

2.2 ACCESSORIES

.1 Resilient base: continuous, top set, complete with premoulded end stops and external corners:
- .1 Type: rubber, 1/8” (3.0 mm) thick.
- .2 Style: cove.
- .3 Height: 4” (101.6 mm).
- .4 Lengths: cut lengths minimum 8’-0” (2400 mm).
- .5 Colour: 63 Burnt Umber B by Tarkett
- .6 Or approved alternate

.2 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.

.3 Concrete Filler Mix: cement based underlayment mix, as recommended by flooring manufacturer. Ardex Feather Finish, Tec Feather Edge or approved alternate.

.4 Metal edge strips: extruded aluminum, smooth, stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.5 Sealer and wax: type recommended by resilient flooring material manufacturer for material type and location.

.6 Moisture Barrier: solvent free, alkali resistant, low viscosity moisture barrier product. Acceptable product: Ardex MC Moisture control, LiquiDam by Tec. or approved alternate.

.7 Metal edge strips: extruded aluminum, smooth, mill finish, with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.8 Welding Rod: flooring manufacturer’s standard, up to 5 colours selected by Owner to suit flooring.

.9 Fillet Strip: Fillet Strip: Johnsonite CFS-00 Cove Filler, 1-3/4" radius or approved alternate.

.10 Self Levelling Materials for infill areas:
- .1 Primer: acrylic latex base, compatible with Self Levelling Compound. Acceptable Product Tec Multipurpose Primer or approved alternate.
- .2 Self Levelling Underlayment: cement based, pourable, pumpable, free flowing underlayment. Acceptable Product: TEC567 by Tec Self Leveling Underlayment or approved Alternate.

Part 3 Execution

3.1 SITE VERIFICATION OF CONDITIONS

.1 Ensure concrete floors are clean and dry by using test methods recommended by flooring manufacturer.

3.2 PREPARATION

.1 The recommendations of the manufacturer of the resilient floor covering shall be considered as minimal.

.2 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

.3 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.

.4 Prime or Seal concrete slab and plywood sub-floor to resilient flooring manufacturer's printed instructions.

3.3 APPLICATION: FLOORING

.1 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.2 Resilient Tile:
- .1 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.
- .2 Install square resilient tile flooring to square grid pattern with all joints aligned.

.3 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.

.4 Cut flooring neatly around fixed objects.

.5 Continue flooring over areas which shall be under built-in furniture.
.6 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
.7 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4 APPLICATION: 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. Use premoulded end pieces at flush door frames.
.7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.
.8 Use coved type base in all areas.

3.5 CLEANING

.1 Remove excess adhesive from floor, base and wall surfaces without damage.
.2 Clean, seal and wax floor and base surface to flooring manufacturer's printed instructions. Apply minimum 2 coats wax to tile floors.

3.6 PROTECTION

.1 Protect new floors in accordance with manufacturer's printed instructions.

End of section

Part 1 General

1.1 **SUMMARY**

.1 This Section includes one resinous flooring system, one with epoxy body.

.1 Application Method: Metal, power and hand trowel

1.2 **SUBMITTALS**

.1 Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

.2 Samples for Verification: For each resinous flooring system required, 5 inches (150 mm) square, applied to a rigid backing.

.3 Maintenance Data: For resinous flooring to include in maintenance manuals.

1.3 **QUALITY ASSURANCE**

.1 Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

.1 Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

.2 Contractor shall have completed at least 10 projects of similar size and complexity.

.2 Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

.3 Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.

.1 Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.

.4 Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.

.2 Include 48-inch (1200-mm) length of integral cove base.

.3 Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

.5 Pre-installation Conference:

1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
2. Attendance:
   - .1 General Contractor
   - .2 Architect/Owner's Representative.
   - .3 Manufacturer/Installer's Representative.

1.4 **DELIVERY, STORAGE, AND HANDLING**

.1 Package, seal and label each flooring material to show manufacturer's and product name, and colour.
.2 Store materials at site in an area specifically set aside for purpose that is locked, ventilated, and maintained at a minimum temperature of 16°C.
.3 Ensure that health and fire regulations are complied with in storage area, and during handling and application.

1.5 **ENVIRONMENTAL REQUIREMENTS**

.1 Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
.1 Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.
.2 Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
.3 Close spaces to traffic during resinous flooring application and for not less than 48 hours after application, unless manufacturer recommends a longer period.
.4 Concrete substrate shall be properly cure. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring

1.6 **WARRANTY**

.1 The warranty period stated in GC 12.3 - WARRANTY, paragraph 12.3.1 & in Supplementary Conditions SC 3.44GC 12.3 Warranty is, with respect to this Section of the Work, extended from one year to three years.
.2 The following shall be considered defects and deficiencies in the Work: delaminating, blistering, discolouration, colour change, shrinkage, and cracking.

Part 2 Products

2.1 MATERIALS

.1 Resinous Flooring:
.1 Acceptable Product:
.1 Stonshield HRI by Stonhard
.2 or Approved Alternate
.2 System Characteristics:
.1 Color and Pattern: Flagstone
.2 Wearing Surface: Medium Texture #1 (refer to drawings for locations)
.3 Integral Cove Base: Match Existing Heights on Site
.4 Overall System Thickness: nominal 3/16”
.3 System Characteristics:
.1 Primer:
.1 Material Basis: Stonhard Standard Primer or approved alternate
.2 Resin: Epoxy
.3 Formulation Description: (2) two component, 100 percent solids.
.4 Application Method: Squeegee and roller.
.5 Number of Coats: (1) one.
2. Mortar Base:
.1 Material design basis: Stonshield HRI Base or approved alternate
.2 Resin: Epoxy.
.3 Formulation Description: (3) three component, 100 percent solids.
.4 Application Method: Metal Trowel.

.1 Thickness of Coats: nominal 1/8" (inch).
.2 Number of Coats: One.
.5 Aggregates: Pigmented Blended aggregate.

3. Undercoat:
.1 Material Basis: Stonshield undercoat or approved alternate.
.2 Resin: Epoxy
.3 Formulation Description: (2) two-component, 100% solids, UV Stable.
.4 Type: Clear.
.5 Finish: Gloss.
.6 Number of Coats: one.

4. Broadcast Media:
.1 Material Basis: Stonshield quartz aggregate or approved alternate
.2 Type: pigmented.
.3 Finish: standard.
.4 Number of Coats: one.
.5 Pattern: Tweed.

5. Sealer:
.1 Material Basis: Stonkote CE4 or approved alternate.
.2 Resin: Epoxy
.3 Formulation Description: (2) two-component, 100% solids, UV Stable.
.4 Type: Clear.
.5 Finish: Gloss.
.6 Number of Coats: one.
.7 Texture level: Standard or medium.

.5 System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
.1 Compressive Strength: 10,000 psi after 7 days per ASTM C579
.2 Tensile Strength: 2,000 psi per ASTM C307
.3 Flexural Strength: 4,300 psi per ASTM C580
.4 Flexural Modulus of Elasticity: 2.0 x 106 psi per ASTM C580
.5 Hardness: 85 to 90 per ASTM D2240, Shore D
.6 Impact Resistance: > 160 in./lbs. per ASTM D2794
.7 Abrasion Resistance: 0.06 gm max. weight loss per ASTM D 4060, CS-17
.8 Flammability: Class 1 per ASTM E-648.
.9 Thermal Coefficient of Linear Expansion: 1.3 x 10-5 in./in. oF
.10 Water Absorption: 0.1% per ASTM C 413
.11 VOC Content per ASTM D2369:
.1 Stonshield HRI Base – 40 g/l
.2 Stonshield Undercoat – 34 g/l
.3 Stonkote CE4 – 34 g/l
.12 Cure Rate @ 77oF/25oC: 12 hours foot traffic, 24 hours normal operations

2.2 ACCESSORY MATERIALS

.1 Patching, Leveling and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

.2 Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated. Allowances should be included for Stonflex MP7 joint fill material or approved alternate.

3 Execution

3.1 EXAMINATION

.1 Verify that existing conditions are suitable for application of Work of this Section.
.2 Defective work resulting from application to unsatisfactory surfaces shall be considered the responsibility of those performing the work of this Section.

3.2 PREPARATION

.1 Following his acceptance of surfaces, fluid-applied flooring applicator shall be responsible for surface preparation not specified under work of other Sections. Prepare existing concrete floors over entire area with commercial shot-blast machine, or other mechanical technique accepted by fluid-applied flooring manufacturer.
.2 Cover or mask surfaces adjacent to those receiving fluid-applied flooring to protect work of others and property from damage and soil.
.3 Materials soiled by fluid-applied flooring during application and storage, and from which soil cannot be completely removed, shall be replaced under work of this Section at no additional cost to Owner.
.4 Fill open control joints, and other cracks and voids with material compatible with fluid-applied flooring materials.
.5 Clean, prime and seal surfaces as recommended by fluid-applied flooring manufacturer.

3.3 APPLICATION

.1 General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
.1 Apply joint sealant to comply with manufacturer's written recommendations.

.2 Integral Cove Base: Stonshield cove mortar, or approved alternate. 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.
1. Integral Cove Base: Height as per drawings

.3 Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.
.4 Apply metal trowel single mortar coat in thickness indicated for flooring system into wet primer. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
.5 Undercoat: Remove any surface irregularities by lightly abrading and vacuuming the floor surface. Mix and apply undercoat with strict adherence to manufacturer's installation procedures and coverage rates.
.6 Broadcast: Immediately broadcast quartz silica aggregate into the undercoat using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.
.7 Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.4 TERMINIATIONS

.1 Chase edges to “lock” the flooring system into the concrete substrate along lines of termination.
.2 Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible

movement.

.3 Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.

.4 Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.5 JOINTS AND CRACKS

.1 Treat control joints to bridge potential cracks and to maintain monolithic protection.

.2 Treat cold joints and construction joints and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.

.3 Vertical and horizontal contraction and expansion joints are treated 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.

3.6 SITE TOLERANCES

.1 Finish surfaces shall be level, or straight where sloped to drains, within a tolerance of 1.5 mm in 3 m, and shall not vary more than 0.8 mm in any running 300 mm.

3.7 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 24 hours.

3.8 REPAIR

.1 Touch-up and refinish minor defective work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

3.9 CLEANING

.1 Remove promptly as work progresses spilled or spattered materials from surfaces of work performed under other Sections. Clean floors on completion of work. Do not mar surfaces while removing.

.2 Leave storage and mixing areas in same condition as equivalent spaces in project.

3.10 PROTECTION

.1 Erect barriers to prevent the entry and presence of personnel not performing work of this Section during application of fluid-applied flooring, and for 48 hours following completion of application.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Painting: Section 09 90 00

1.2 REFERENCES

.1 American Society for Testing & Materials (ASTM):

.1 AST ASTM E 84-05 Standard Test Method for Surface Burning Characteristics of Building Materials. CLASS A

.2 ASTM D5420 Gardner Impact Exceeds 160 inch pounds

1.2 SUBMITTALS

.1 Shop Drawings: Submit shop drawings in accordance with Section 01 33 00, Submittal Procedures, indicating layout, treatment of joints.

.2 Samples: Submit samples of wall protection

.3 Maintenance Data: Submit maintenance material to be included with maintenance manuals specified in Section 01 78 00 – Closeout Procedures & Submittals. Include complete, detailed and specific instructions for maintaining shower wall and ceiling cladding.

1.3 QUALITY ASSURANCE

.1 Application of materials shall be by an approved firm using tradesmen experienced and skilled in installation of wall protection. All work shall be under the supervision of a competent foreman at all times.

.2 If requested, submit history of successful applications for this type of work.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Store materials in areas designated. Protect materials from damage.

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Air temperature and structural base temperature at wall covering installation area must be 20°C for 72 hours before, during and 48 hours after installation.

.2 Unwrap wall covering and allow to acclimatize in installation area for 24 hours before application.

Part 2 Products

2.1 MATERIALS

.1 Vinyl Wall Protection (VW): 060” (1.52 mm) thick, supplied in 48” wide x 96” or 120” sheets, Pebblette texture, Oyster Gray

.1 Acceptable Product: C/S Acrovyn High Impact Wall Covering, manufactured by Construction Specialties Inc or approved alternate.

.2 Adhesive, Sealants and Trim: manufacturer’s standard type to provide complete installation, adhered to wall and finished tops and joint

.3 Sealing compound: as recommended by manufacturer.

Part 3 Execution

3.1 PREPARATION

.1 Ensure wall substrates are smooth and level to within 3 mm in 3 m. (1/8" in 10'-0").

3.2 INSTALLATION

.1 Ensure surfaces are firm, smooth and dry, free from loose material and lime burn, and as recommended by wall covering manufacturer.

.2 Work penetrating substrata to be completed before installing wall protection.

.3 Apply adhesive and wall protection in accordance with manufacturer's instructions.

.4 Install in compliance with manufacturer's printed instructions.

.5 Immediately upon completion of installation, clean wall protection and accessories in accordance with manufacturer's recommended cleaning method.

.6 Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work of this section.

3.3 CLEANING

.1 Wash with dilute soap/water/detergent solution and rinse with clean water.

End Of Section

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Material and installation of site applied paint finishes to new interior surfaces, including site painting of shop primed surfaces.

1.2 REFERENCES

.1 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33

.2 Environmental Protection Agency (EPA)

.1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.4 Master Painters Institute (MPI)

.1 MPI Architectural Painting Specifications Manual, 2004.

.5 National Fire Code of Canada - 1995

.6 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

.7 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.

.3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health & Safety Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 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 two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS).

.3 Samples:

.1 Submit full range colour sample chips to indicate where colour availability is restricted.

.2 Submit 200 x 300 mm sample panels of each paint, stain or clear coating with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards.

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions:

.1 Submit manufacturer's installation and application instructions.

.6 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Procedures & Submittals include following:
- .1 Product name, type and use.
- .2 Manufacturer's product number.
- .3 Colour numbers.
- .4 MPI Environmentally Friendly classification system rating.

1.5 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 degrees C to 30 degrees 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 Type ABC 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.
  - .4 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

1.6 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:
- .1 Ventilate enclosed spaces in accordance with Section 01 51 00 Temporary Utilities.
- .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 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.
- .5 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:
- .1 Perform no painting when:

.1 Ambient air and substrate temperatures are below 10 degrees C.
.2 Substrate temperature is above 32 degrees 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 under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. 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 Allow new concrete and masonry to cure minimum of 28 days.
.2 15% for wood.
.3 12% for plaster and gypsum board.

.3 Test for moisture using calibrated electronic Moisture Meter.

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.5 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 shall 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.

.6 Additional interior application requirements:
.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

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 interior 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 Water-based.
.2 non-flammable.
.3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
.4 Manufactured without compounds which contribute to smog in the lower atmosphere.
.5 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 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:

.1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of [15] mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.

.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of [15] mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.

2.2 COLOURS

.1 Colours as listed below:

.1 As per First Floor Room Finish Schedule – PT Colours

.2 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site.

.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.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

2.5 INTERIOR PAINTING SYSTEMS

.1 Acceptable Products:

.1 PPG Pitt-Glaze WF5 pre-catalyzed water-borne acrylic epoxy

.2 Corotech High Performance pre-catalyzed water-borne acrylic epoxy

.3 or approved alternate

.2 Concrete masonry units: smooth and split face block and brick:

.1 Semi Gloss level 5

.3 Galvanized metal: doors, frames, railings, misc. steel, pipes and ducts.
.1 Semi Gloss level 5
.4 For Structural Steel components:
.1 Two coats Glidden Solventborne Interior Eggshell Dry Fall 1582-1200 or approved alternate.
.2 Primer - Glidden 1370 Solventborne Direct-to-metal Primer or approved Alternate.
.5 For Gypsum Wall Board: Eggshell Gloss Level 3
.6 For woodwork to receive stained finish apply
.1 One coat wood filler
.2 Two coats solvent based stain CAN/CGSB-1.145. Type 2 (interior) Class B semi Transparent.
.3 One coat oil modified clear polyurethane CAN/CGSB-1.175 Type 1 gloss
.4 Two coat oil modified clear polyurethane CAN/CGSB-1.175 Type 2 satin
.7 For woodwork to receive clear finish apply:
.1 One coat wood filler
.2 One coat oil modified clear polyurethane CAN/CGSB-1.175 Type 1 gloss
.3 Two coat oil modified clear polyurethane CAN/CGSB-1.175 Type 2 satin

2.6 EXTERIOR PAINTING SYSTEMS

.1 Concrete Masonry Units: smooth and split face block and brick
.1 EXT 4.2A - Latex Gloss Level 3 finish.
.2 Structural Steel and Metal Fabrications:
.1 EXT 5.1A - Quick dry enamel Gloss Level 3 finish.
.3 Galvanized Metal: not chromate passivated
.1 EXT 5.3A - Latex Gloss Level 5 finish.
.4 Dimension Lumber: columns, beams, exposed joists, underside of decking, siding, fencing, etc.
.1 EXT 6.2A - Latex Gloss Level 5 finish (over alkyd primer).
.5 Dressed Lumber: doors, door and window frames, casings, battens, smooth facias, etc.
.1 EXT 6.3A - Latex Gloss Level 5 finish.

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 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 Clay and Concrete Block/Brick: 12%.
.4 Wood: 15%.

3.4 PREPARATION

.1 Protection:
.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by [Departmental Representative] [DCC Representative] [Consultant].
.2 Protect items that are permanently attached such as Fire Labels on doors and frames.
.3 Protect factory finished products and equipment.
.4 Protect [passing pedestrians], [building occupants] [and general public] in and about the building.

.2 Surface Preparation:
.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
.3 Place "WET PAINT" signs in occupied areas as painting operations progress.

.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
.1 Remove dust, dirt, and other surface debris by wiping with dry, clean cloths.
.2 Wash surfaces with a biodegradable detergent [and bleach where applicable] and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
.4 Allow surfaces to drain completely and allow to dry thoroughly.
.5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
.6 Use trigger operated spray nozzles for water hoses.
.7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.

.4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
.2 Apply wood filler to nail holes and cracks.
.3 Tint filler to match stains for stained woodwork.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes.

.8 Touch up of shop primers with primer as specified.

.9 Do not apply paint until prepared surfaces have been accepted by Consultant.

3.5 APPLICATION

.1 Method of application to be as approved by Consultant. Apply paint by brush, roller or 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 and/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 and 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 time 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.

3.6 MECHANICAL ELECTRICAL EQUIPMENT

.1 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.

.2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.5 Do not paint over nameplates.

.6 Keep sprinkler heads free of paint.

.7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.8 Paint exposed fire protection piping to match ceiling.

.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.

3.7 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.

3.8 FIELD QUALITY CONTROL

.1 Interior painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the specifying authority and local Painting Contractor's Association. Painting contractor shall notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.

.2 Interior surfaces requiring painting shall be inspected by Paint Inspection Agency who shall notify Consultant and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.

.3 Standard of Acceptance:

- .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 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.

.4 Advise Consultant when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.5 Cooperate with inspection firm and provide access to areas of work.

3.9 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashing on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

End Of Section

1.1 RELATED SECTIONS

.1 Rough Carpentry: Section 06 10 00

1.2 SHOP DRAWINGS

.1 Submit shop drawings or catalogue illustrations in accordance with Section 01 33 00 Submittal Procedures

.2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details.

1.3 MAINTENANCE DATA

.1 Provide maintenance data for manufactured specialties for incorporation into manual specified in Section 01 77 00 Closeout Procedures and Submittals.

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Provide additional reinforcing as required, fastenings, and anchorage required for building in of products.

.2 Insulate between dissimilar metals and metal and masonry materials to prevent electrolysis with bituminous paint to meet requirements of CAN/CGSB-1.108-M89, or with methacrylate lacquer, CAN/CGSB 1.159-92 if exposed to view.

.3 Specified products are minimum acceptable quality. Manufacturer's standards exceeding specified quality will be accepted.

2.2 METAL SHELVING

.1 Provide wire shelving storage system, specifications based on Rubbermaid Fasttrack System with TightMesh shelving or approved alternate, as follows:

.1 Shelving: white epoxy coated steel, wire spacing 1/2" apart, shelving module

.2 Rails: prefinished metal, white colour, 80" long, designed for mechanical attachment into wall, purpose made for Upright attachment. Rubbermaid Fasttrack Rails or approved alternate.

.3 Uprights: prefinished metal, spaced at 24" o.c., Rubbermaid Fasttrack Uprights or approved alternate.

.4 Brackets: prefinished metal, suitable for 20" deep shelf. Rubbermaid Fasttrack brackets or approved alternate.

.5 Hardware: manufacturer's standard hardware kit.

2.2 KENNEL GUILLOTINE DOORS

.1 Supply and Install kennel guillotine doors, 17.5" wide by 29" tall, complete with handle catch, Aluminium Pulley and locking assembly. Exterior application, Min R5 insulated. Acceptable Manufacturers:

.1 Stone Mountain Pet Products

.2 Mason Company

.3 Or approved alternate.

2.3 KENNEL STALL DOORS AND GLASS

.1 Supply and Install kennel stall fronts with glass., Stainless steel frame c\w bottom frame.

.1 Size: As per drawings

.2 Glass: Full Height tempered glass, glass as per manufacturer's standard

.3 Latch: two-way stainless steel

.4 Accessories: Rotary Double Bowl Insert.

.5 Acceptable Manufacturers:

.1 Mason Company
.2 Or approved alternate.

Part 3 Execution

3.1 INSTALLATION

.1 Install all items in accordance with manufacturer's instructions.
.2 Supply templates, components and instructions for items built into work of other sections.
.3 Apply bituminous paint to aluminium in contact with concrete or masonry.
.4 Install items plumb, straight and level to a tolerance of 1:500.
.5 Securely fix items in place with concealed fasteners.

End of Section

Part 1 General

1.1 RELATED SECTIONS

.1 Rough Carpentry: Section 06 10 00.

1.2 REFERENCES

.1 CAN/CGSB-12.5-M86, Mirrors, Silvered.

.6 CAN/CSA-B651-07(r012), Barrier-Free Design.

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with section 01 33 00.

.2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.

1.4 SUBMITTALS

.1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00 – Closeout Procedures & Submittals

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 77 00.

Part 2 Products

2.1 MATERIALS

.1 Sheet steel: commercial quality to ASTM A526M with ZF001 designation zinc coating.

.2 Stainless steel sheet metal: to ASTM A167, Type 304 with BA finish.

.3 Stainless steel tubing: Type 304, commercial grade, seamless welded, 1.2 mm wall thickness.

.4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 ACCESSORIES

.1 Refer to drawings for accessories schedule.

.2 Install all washroom accessories that are supplied by owner, as indicated on the drawings

.3 Accessory schedule is based on Frost Products Limited. ASI Watrous, Bobrick Washroom Equipment and Bradley Corp accessories or approved alternates.

2.3 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.

2.4 FINISHES

.1 Chrome and nickel plating: to ASTM B456, satin or polished finish.

Part 3 Execution

3.1 INSTALLATION

.1 Install and secure accessories rigidly in place as follows:
- .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
- .2 Hollow masonry units or existing plaster/drywall: use toggle bolts drilled into cell/wall cavity.
- .3 Toilet/shower compartments: use male/female through bolts.

.2 Install grab bars on built-in anchors provided by bar manufacturer.

.3 Use tamper proof screws/bolts for fasteners.

.4 Install mirrors in accordance with manufacturer's instructions and CSA B651.

3.2 SCHEDULE

.1 Locate accessories where indicated. Exact locations determined by Consultant.

.2 Refer to Washroom Accessories Schedule located on drawings.

3.3 ADJUSTING

.1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.

.2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.2 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion of this section. Remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.4 Waste Management: separate waste materials for reuse or recycling.

.5 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

End Of Section

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 10 00 Rough Carpentry

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-44.40-01, Steel Clothing Locker.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for metal lockers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings: type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, bases, trim, filler panels, end/back panels, doors, handles, finishes.

.4 Samples:

.1 Submit duplicate samples of colour and finish.

1.4 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:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect [metal lockers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse of pallets, crates, packaging materials.

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Double Stack Lockers: to CAN/CGSB-44.40, five tier locker, freestanding.

.1 Size: 15” wide x 12” deep x 60” Two Teir high, steel thickness 24 ga for body.

.2 Assembly: pop-riveted construction.

.3 Top: Flat.

.4 Doors: one-piece double-wall envelope construction, steel thickness 20 ga. Outer panel, 24 ga inner panel, door swing as noted on drawings.

.5 Door handle: recessed handle, manufacturer’s standard.

.6 Base: locker manufacturer’s standard 14 ga., continuous Z-base, anchored directly to the floor, 4” (102 mm) x 60” (1524 mm) lengths, complete with manufacturer’s standard fastening devices.

.7 Finish: Locker manufacturer’s standard Epoxy Powder Coating, colour selected by Owner from manufacturer’s standard range.

.8 Acceptable Product: Hadrian Emperor or approved alternate.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates and surfaces to receive metal lockers previously installed under other Sections or Contracts are acceptable for product

installation in accordance with manufacturer's instructions prior to metal locker installation.

.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 Assemble and install lockers in accordance with manufacturer's written instructions.

.2 Securely fasten lockers to grounds and nailing strips.

.3 Install wall trim around recessed locker banks.

.4 Install filler panels (false fronts) where indicated and where obstructions occur.

3.3 ADJUSTING

.1 Adjust metal lockers for correct function and operation in accordance with manufacturer's written instructions.

.2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion of this section remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse or recycling.

.4

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal locker installation.

End Of Section

Part 1 General

1.1 RELATED WORK

.1 Rough Carpentry: Section 06 10 00

.2 Aluminum Window Framing: Section 08 11 16

1.2 REFERENCES

.1 ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films.

1.3 SUBMITTALS

.1 Submit under provisions of Section 01 33 00 Submittal Procedures.

.1 Product Data: Submit Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.

.3 Storage and handling requirements and recommendations.

.4 Mounting details and installation methods.

.2 Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.

.3 Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

.4 Selection Samples: For each finish product specified, one set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.

.5 Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.4 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.

.2 Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

.3 Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

.4 Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.6 PROJECT CONDITIONS

.1 Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

.1 Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating twenty-five year limited warranty.

.2 Standard Shadecloth: Manufacturer's standard twenty-five year warranty.
.3 Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas.

Part 2 Products

2.1 GENERAL

.1 This specification is based on manually operated roller shades.

2.2 MANUFACTURER'S

.1 Work of this section shall be provided by one of the following manufacturer's
  .1 Solarfective Products Limited
  .2 MechoSystems, ThermoVeil Collection
  .3 or approved alternate

2.3 ROLLER SHADE TYPES

.1 Manually Operated Shades:
  .1 Mounting: Surface mounted with metal fascia.
  .2 Configuration: Solar shadecloth.
  .3 Solar Shadecloths:
    .1 Visually Transparent Shadecloth Fabric: single thickness non-raveling 0.037inch (0.94 mm) thick vinyl fabric, extruded vinyl yarn comprising of 25 percent polyester and 75 percent vinyl on polyester. 3 percent open.
    .2 Color: Selected by Consultant from manufacturer's standard colors.
      .1 WC1: Style 2410-3% P13 Oyster/ Beige Solarfective by Legrand.
      .2 or approved alternate.

2.4 SHADE BAND

.1 Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
.2 Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
.3 Shade Band and Shade Roller Attachment:
  .1 Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
  .2 Provide for positive mechanical engagement with drive / brake mechanism.
  .3 Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
  .4 Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
  .5 Provide shade manufacturer’s standard brush attachment for “self-cleaning” of shades while retracting.

2.5 SHADE FABRICATI0N

.1 Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
.2 Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shadebands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and

rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

2.6 COMPONENTS

.1 Access and Material Requirements:

.1 Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.

.2 Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.

.3 Manual Operated Chain Drive Hardware and Brackets:

.1 Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.

.2 Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.

.3 Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.

.4 Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.

.5 Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.

.6 Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable

.7 Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.

.8 Drive Bracket / Brake Assembly:

.1 Shade Drive Bracket shall be fully integrated with all Shade accessories.

.2 Drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch (9.525 mm) steel pin.

.3 The brake shall be an over-running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. (22 kg) in the stopped position.

.4 The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.

.5 The entire assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.

.6 Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength. Nickel plate chain shall not be accepted.

2.7 ACCESSORIES

.1 Fascia:

.1 Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.

.2 Fascia shall be able to be installed across two or more shade bands in one piece.

.3 Fascia shall fully conceal brackets, shade roller and fabric on the tube.

.4 Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.

Part 3 Execution

3.1 EXAMINATION

.1 Do not begin installation until substrates have been properly prepared.

.2 If substrate preparation is the responsibility of another installer, notify Consultant of unsatisfactory preparation before proceeding. Beginning work signifies acceptance of substrate conditions.

3.2 PREPARATION

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

.1 Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.

.2 Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

.3 Clean roller shade surfaces after installation, according to manufacturer's written instructions.

.4 Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.4 PROTECTION

.1 Protect installed products until completion of project.

.2 Touch-up, repair or replace damaged products before Substantial Completion.

End Of Section

ISSUED FOR TENDER

MECHANICAL & ELECTRICAL SPECIFICATIONS

FOR

BRANTFORD ANIMAL SHELTER

V&R PROJECT #23-013

August 12, 2024

Vanderwesten & Rutherford Associates Inc.

Consulting Mechanical & Electrical Engineers
1130 Morrison Dr. Suite 140
Ottawa, ON K2H 9N6

ENGINEERING FORWARD

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1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and meet requirements of:
  .1 Division 1 requirements and documents referred to therein.
.2 Section 20 01 01 applies to and governs the work of all Sections of Mechanical Divisions 20, 21, 22, 23 and 25.
.3 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish subcontract limits between any Sections of the work.
.4 The specifications are integral with the drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.
.5 Wherever differences occur in the tender documents, the most onerous condition governs. Base the bid on the costliest arrangement.

1.2 WORK INCLUDED

.1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
.2 Cutting and patching of new or existing work.
.3 Identification of equipment, piping, ductwork, valves, and controllers.
.4 Concrete equipment bases, housekeeping pads, sump pits and trenches.
.5 Motors required for equipment supplied under Mechanical Divisions 20, 21, 22, 23.
.6 Variable frequency drives for motors and equipment supplied under Mechanical Divisions 20, 21, 22, 23.
.7 Internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or electrical or electronic components under Mechanical Divisions 20, 21, 22, 23, 25.
.8 Disconnect switches for exhaust fans located on the roof complete with:
  .1 EEMAC 1 enclosure if housed within a weatherproof cabinet,
  .2 EEMAC 3 enclosure if exposed to weather.
.9 Take such measures and include in Bid Price for the proper protection of the existing building and its finishes at all times during alterations and construction of the new addition. Coordinate this protective work with all trades.
.10 Refer to Mechanical/Electrical Equipment Schedule for extent of wiring and electrical characteristics.
.11 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval before starting and/or returning to operation.

1.3 RELATED WORK

.1 Power wiring, conduit, and connections for motors under Mechanical Divisions 20, 21, 22, 23 shall be by Electrical Division 26.
.2 Power wiring, conduit, and connections to variable frequency drives for motors under Mechanical Divisions 20, 21, 22, 23, 25 shall be by Electrical Division 26. Wiring and connections from VFD to motors under Mechanical Divisions 20, 21, 22, 23, 25 shall be by Electrical Division 26.
.3 Flashings for mechanical equipment and services located on or passing through roofs shall be provided under Division 7. Supply counter flashings, and integral flashing collars on equipment and piping under Mechanical Divisions 20, 21, 22, 23, 25.
.4 Painting of exposed piping and ductwork other than for identification shall be supplied under Division 09.
.5 Concrete equipment bases, housekeeping pads, sump pits and trenches shall be provided under Division 03.

1.4 METRIC AND IMPERIAL MEASUREMENTS

.1 Both Imperial and Metric units of measurement are indicated in the Mechanical Specification.

1.5 SUBMITTALS

.1 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction and obtain two (2) copies of approved drawings for retention by consultant before commencement of work under Mechanical Divisions 20, 21, 22, 23, 25.

.2 Shop Drawings: Prepare and submit one (1) electronic copy of shop drawings of major equipment items (including those items specifically indicated under Part 1: General of each Section), to the Consultant for review. The Consultant shall return one electronic copy, marked with comments and their review stamp as deemed appropriate. Prepare the necessary number of copies of the returned set and distribute to the Owner, the Prime Consultant, the General Contractor, the site, and to subcontractors and suppliers.

.1 Clearly indicate manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities, and performance. Before submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by consultant, has been returned to Contractor.

.2 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.

.3 The Consultant shall not review shop drawings that fail to bear the Contractor's stamp of approval or certification.

.4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted:

"*This review by the Consultant is for the sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant 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 his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades.*"

.3 Sleeving Drawings: Prepare and submit one (1) copy of sleeving drawings to clearly and accurately indicate the exact location, elevation and size of any and all formed holes, recesses and sleeving required in the work of Mechanical Divisions 20, 21, 22, 23, 25. Obtain Consultant's approval in writing before sleeving, forming or cutting any such opening. Provide a copy of approved sleeving drawings to the reinforcement detailer well in advance of planned pours.

.4 Composite Wiring Diagrams: Prepare and submit one (1) copy of complete composite wiring diagrams of each specific mechanical system. Indicate all electrical equipment and wiring, both internal and external, for review and coordination of trades.

.5 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they meet the requirements of those documents (e.g. NFPA-Standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:

.1 Description of the system (description and type),

.2 Description of the tests conducted, and results observed, including re-testing, where necessary,

.3 Description of any corrective measures undertaken,

.4 Description of materials used (pipe and fittings),

.5 List of witnesses for each test conducted,

.6 Date system left ready for service,

.7 Signature of Installing Contractor.

.6 Directories & Schematics

.1 Submit a copy of a neat directory indicating the valve number, related service, and location of each valve under Mechanical Divisions 20, 21, 22, 23, 25.

.2 Submit one (1) copy of system control schematics for each mechanical system indicating

relative locations of equipment and control devices.

.3 Provide one (1) copy of each directory/schematic under glass in a neat polished 18" x24" (460 mm x 610 mm) metal frame, complete with mounting clips.

.7 Maintenance Data and Operating Instructions

.1 Submit prior to application for Substantial Performance, one (1) hard copy bound in hard backed three-ring binder and one (1) PDF format clearly marked and labelled accordingly.

.2 Ensure the binder spines have typewritten lettering as follows:

OPERATION & MAINTENANCE MANUAL
for
Brantford Animal Shelter
[Insert date of submission]
[Insert Division Title]

.3 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, general contractors, architect, and Consultant. Include special telephone numbers for service departments on normal and emergency call basis.

.4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item. Shop drawing or product data sheet to be “Reviewed” or “Reviewed As Modified” with manufacturer’s/supplier’s name, telephone, email address, and the contact information for local source of parts and service.

.5 Include copies of start-up reports and checklists and all certificates issued with respect to this contract.

.6 Ensure operating instructions include the following:

.1 General description of each mechanical system.

.2 Step by step procedure to follow in putting each piece of equipment into service.

.3 Schematic control diagrams for each separate mechanical system, control thermometers, freezestats, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark the correct operating settings for each control device on these diagrams.

.4 Diagram of the electrical control system indicating the wiring of all related electrical components such as PE and EP switches, firestats, freezestats, fuses, interlocks, electrical switches, and relays.

.5 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.

.7 Ensure maintenance instructions include the following:

.1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of supplier and maintenance and lubrication instructions.

.2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.

.3 Equipment directory indicating name, model, serial number, and nameplate data of each item of equipment supplied, and system with which it is associated.

.4 Include Owner’s equipment numbers on all equipment submitted.

.5 Balancing and testing reports.

.6 Copy of valve directory.

.8 As-Built Records: Prepare and submit complete as-built records before Substantial Performance of the Contract. Refer to Division 1 for requirements.

.9 Requests for Shut-Down: Obtain permission for systems shut-down and/or service interruption from the Owner before disruption of any system or service in use by the Owner. Employ the Owner's standard form of request where available. Refer to Division 01 for additional requirements.

.10 Requests for Start-up: Obtain permission from the Owner to start-up or to return to service any item of equipment, system or service installed new or previously shutdown. Refer to Division 1 for additional requirements.

1.6 QUALITY ASSURANCE

.1 Meet the requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.

.2 Ensure materials supplied under this Division meet the requirements and recommendations or better of applicable standards of the following:

.1	AABC	Associated Air Balance Council
.2	AMCA	Air Moving and Conditioning Association
.3	ANSI	American National Standards Institute
.4	ASA	American Standards Association
.5	ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
.6	ASME	American Society of Mechanical Engineers
.7	ASSE	American Society of Sanitary Engineers
.8	ASPE	American Society of Plumbing Engineers
.9	ASTM	American Society of Testing and Materials
.10	AWWA	American Water Works Association
.11	CAN2	National Standard of Canada (Published by CGSB)
.12	CAN3	National Standard of Canada (Published by CSA)
.13	CGSB	Canadian General Standards Board
.14	CSA	Canadian Standards Association
.15	EEMAC	Electrical & Electronic Manufacturer's Association of Canada
.16	NBC	National Building Code of Canada
.17	NEBB	National Environmental Balancing Bureau
.18	NFPA	National Fire Protection Association
.19	NEMA	National Electrical Manufacturers Association
.20	OBC	Ontario Building Code
.21	OFC	Ontario Fire Code
.22	OFM	Ontario Fire Marshall
.23	SMACNA	Sheet Metal & Air Conditioning Contractors National Association
.24	TIAC	Thermal Insulation Association of Canada
.25	ULC	Underwriter's Laboratories of Canada Ltd.
.26	UL	Underwriter's Laboratories (including cUL)

.3 Use latest editions and amendments in effect on date of Bid call subject to requirements of OBC.

.4 Arrange and pay for permits and inspections by authorities having jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.

.5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or Owner when requested.

.6 All welding and brazing shall be executed by certified welders in accordance with registered procedures.

.7 All refrigeration work shall be executed only by mechanics with valid ODP cards.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

.1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.

.2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under Mechanical Divisions 20, 21, 22, 23, 25 that are received at the site by respective Division.

1.8 JOB CONDITIONS

.1 Visit site and examine existing conditions which may affect work of this Mechanical Divisions 20, 21, 22, 23, 25.

.2 Examine all Contract Documents to ensure that work of respective Division may be satisfactorily completed.

.3 Notify Consultant upon discovery of conditions which adversely affect work of Mechanical Divisions 20, 21, 22, 23, 25. No allowance shall be made after letting of contract for any expenses incurred through failure to do so. No extras shall be granted due to lack of a thorough preliminary investigation of the site.

.4 Remove and replace existing ceiling tile to inspect ceiling space for existing Mechanical, Electrical and Structural obstructions. Include cost of all necessary changes in Bid Price. No extras shall be granted due to lack of a thorough preliminary investigation of accessible ceiling spaces. Obtain permission from the Owner before removing any ceiling tiles.

.5 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications unless exceptions are specifically noted in the Bid.

1.9 WARRANTY

.1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.

.2 Make submissions necessary to register product warranties to the benefit of the Owner.

.3 Submit to Consultant, before Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one year or offering greater benefits than required in specifications and in the Owner's name.

.4 All extended warranties specified in mechanical work Sections of the Specifications are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.10 DEFINITIONS

.1 The following are definitions of words found in this specification and on associated drawings under this Division:

.1 "Concealed"-locations hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.

.2 "Exposed"-mechanical work normally visible to building occupants.

.3 "Furnish"- (and its derivatives) has the same meaning as the term "Supply".

.4 "Install"- (and its derivatives) - receive, store and handle at the site, mount, and support and connect all required services. Includes adjustments and calibration, testing, commissioning inspection by authorities having jurisdiction and documentation.

.5 "Provide" - (and its derivatives) - supply, install in place, connect the associated required. services ready for operation, adjust and calibrate, test, commission, warrant, and document. Includes inspection by authorities having jurisdiction.

.6 "Supply"- (and its derivatives) purchase and deliver to the site for installation. Include submittals, manufacturer's field inspection and warranty.

.7 "Wet" - locations exposed to moisture, requiring special materials and arrangement.

.8 “Consultant”-means the Architect or Consulting Engineer who has prepared the Contract.

.9 “Owner”- means Building Owner as defined in the Contract or the Owner’s designated. representative.

.10 “Governing Authority” and/or “Regulatory Authority” and/or “Municipality Authority”-means all government departments, agencies, standards, rules and regulations that apply to and govern the mechanical work and to which the work must adhere.

.11 “O&M”-means Operating and Maintenance.

.2 Wherever the words “indicated”, “shown”, “noted”, “listed”, or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is “indicated”, “shown”, “noted”, “listed”, or “noted” on the drawings.

.3 Wherever the words “approved”, “satisfactory”, “as directed”, “submit”, “permitted”, “inspected”, or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is approved by”, “satisfactory”, “as directed by”, “submit”, “permitted by”, “inspected by”, the Consultant.

1.11 INTERRUPTIONS

.1 Arrange execution of work to maintain present building operations, and to minimize the effect of work under Mechanical Divisions on existing operations.

.2 Before interrupting any existing service notify the Owner and Consultant, in writing, at least 7 days in advance and obtain written authorization. Do not interrupt any existing service without Consultant's

specific authorization. Refer to Division 01 for requirements.

.3 Arrange time and duration of interruption through the Owner. Include in Bid Price for all overtime or premium time hours necessary to minimize duration of service interruption.

.4 Test and verify the proper operation of existing equipment and systems that are shut down due to work of this project, before returning to service.

.5 Assume responsibility for consequential costs on failure to obtain permission to shut down and/or start-up any item of equipment, system or service.

2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

.1 Ensure materials and equipment provided under Mechanical Divisions 20, 21, 22, 23, 25 are new and free from defects and bear labels of approval as required by codes referred to each Division and/or by inspection authorities.

.2 Ensure apparatus and equipment provided under Mechanical Divisions 20, 21, 22, 23, 25 bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.

.3 Ensure manufacturers and suppliers of equipment or materials under Mechanical Divisions 20, 21, 22, 23, 25 determine if their products are composed of any hazardous materials. If they are, the products are suitably labeled and supplied with Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site before doing so.

.4 When utilizing any products that are hazardous, keep Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

2.2 ACCEPTABLE PRODUCTS

.1 First item named or specified by catalogue number meets specifications regarding performance, quality of material and workmanship, and is acceptable to the Consultant.

.2 Items, other than first named, meeting specifications regarding quality of materials and workmanship are acceptable to the Consultant, only, if they also meet performance and/or capacities specified and can be accommodated within the space allotted. Where the Contractor uses equipment other than that first named, on which the design is based, they shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such drawings shall be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in Bid Price.

.3 General approval indicated by inclusion of other manufacturers named is subject to final review of shop drawings, performance data and test reports.

2.3 SUBSTITUTIONS DURING PROGRESS OF WORK

.1 If during the progress of work, specified products are not obtainable, equivalent, or similar products by other manufacturers may be permitted by Consultant.

.2 Apply, in writing, to Consultant for substitution of any products, indicating the following:

- .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities, and performance of proposed products.
- .2 Reason for substitution.
- .3 Any revisions to the contract price made necessary by substitution.
- .4 Any revisions to the contract time made necessary by substitution.
- .5 Any revisions to layout, arrangement or services made necessary by substitution.

.3 No substitutions shall be permitted without written authorization from the Owner and Consultant.

2.4 CONSULTANT'S REVIEW

.1 The Consultants shall review and evaluate unsolicited alternatives and substitutions proposed by the Contractor. Such review and evaluation work shall be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations.

.2 The Contractor shall also reimburse the Owner for any and all costs incurred in updating Contract Documents to reflect such changes.

3 EXECUTION

3.1 RELATIONSHIP WITH OTHER TRADES

.1 Cooperate with other trades whose work affects or is affected by work of Mechanical Division to ensure satisfactory installation and to avoid delays.

.2 Provide materials to be built-in, such as sleeves, anchors, and inserts, together with templates and/or measurements, promptly when required by other trades.

.3 Provide structural supports for equipment to be mounted on or in walls, supported above floors and/or suspended from the structure.

3.2 INSTALLATION REQUIREMENTS

.1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings before installation.

.2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.

.3 Confirm the exact location of outlets, fixtures, and connections. Confirm location of outlets for equipment supplied under other Divisions.

.4 Install equipment and apparatus to allow free access for maintenance, adjustment, and eventual replacement. Verify equipment access and coordinate with equipment supplier to ensure equipment can be physically transported to installation location. Under no circumstances shall any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which shall be considered as part of the equipment installation.

.5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.

.6 Provide suitable shielding and physical protection for devices.

.7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.

.8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.

.9 Do not use power activated tools without written permission of the Consultant. Use them in accordance with the Owner's health and safety policies.

.10 Ensure that the load onto structures does not exceed the maximum loading per square metre indicated on the structural drawings or as directed by the Consultant.

3.3 CONTRACT DRAWINGS

.1 The drawings of Mechanical Divisions 20, 21, 22, 23, 25 are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given. No allowance shall be made for additional costs arising from the failure to obtain proper clarification of conflicting information before Bid.

.2 Obtain accurate dimensions from the architectural and structural drawings, or by measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.

.3 Make changes where required to accommodate structural conditions, (beams, columns, etc.). Obtain Consultant's approval before proceeding.

.4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 10 feet (3 Metre) in any direction without a change to the contract price. The Consultant reserves the right to revise the locations of equipment

and outlets within any given room without altering the Contract Price provided Notice of Change is given before rough-in.

.5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling drawings may differ from that shown on the mechanical drawings. Make the installation in accordance with the latest architectural ceiling drawings. Provide the equipment as specified and/or shown on the documents of Mechanical Divisions 20, 21, 22, 23, 25.

.6 The drawings of Mechanical Divisions 20, 21, 22, 23, 25 are intended for tender pricing. The quantities and quality to be included in the bid price shall be based on the layout and specifications as shown on the mechanical documents. If there is a difference in quantity between the architectural and mechanical drawings, base the contract price on the greater quantity. No adjustment to the Contract Price shall be allowed to complete the work.

.7 Prepare installation (construction) drawing to reflect the latest architectural ceiling layout.

3.4 CONSTRUCTION DRAWINGS

.1 Prepare fully dimensioned drawings showing devices, fixtures, equipment, outlets, sleeves, and openings through structure. Indicate locations and weights on load points.

.2 Prepare fully dimensioned construction drawings of products and services suitably interfaced with work of the sub-trades, in mechanical rooms, service and ceiling spaces, and other critical locations. Coordinate the work with other divisions. Base drawings on reviewed shop drawings and latest architectural drawings. Indicate details pertaining to the following: access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevation of pipes, ducts, conduits.

.3 Prepare drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.

.4 Submit construction drawings to other Divisions. Provide one (1) print copy and one (1) electronic copy of construction drawings to the Consultant for record purposes.

.5 Submit construction drawings before commencement of work.

3.5 RECORD DRAWINGS

.1 Maintain project "as-built" record drawings. Identify each set as "Project Record Copy".

.2 Record deviations from contract documents caused by site conditions or by changes ordered by the Consultant. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of consultants' documents.

.3 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.

.4 Record location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.

.5 Transfer records from the "Project Record Copy" to a Memory/USB stick in AutoCAD format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.

.6 Submit the "Project Record Copy" on one or more Memory/USB stick with PDF prints of each drawing to the Consultant at the time of Substantial Performance.

3.6 USE OF EQUIPMENT

.1 For the duration of this contract, do not use any piece of equipment provided under this contract for the purposes of heating, ventilation, or air conditioning without the specific authorization of the Owner and Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to begin.

.2 Where specific written authorization is given for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution systems or air handling equipment that is not in use. Provide filters over openings in ductwork, over grilles, diffusers, and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

3.7 SPECIAL TOOLS AND SPARE PARTS

.1 Within 30 days of award of contract, prepare a complete itemized list of special tools and spare parts and submit to consultant for review. List shall be used as a checklist and should include provision for sign off by the Owner on receipt.

.2 On completion of the project furnish spare parts to the Owner as follows:

- .1 One set of mechanical seals for each pump.
- .2 One casing joint gasket for each pump.
- .3 One head gasket for each heat exchanger.
- .4 One glass for each gauge glass installed.
- .5 One set of v-belts for each piece of machinery.
- .6 One set of new filters for each filter bank installed.

.3 Identify spare parts containers as to contents and replacement parts number.

.4 Provide one set of special tools required to service equipment as recommended by manufacturers.

.5 Furnish one grease gun and adaptors to suit different types of grease and fittings.

3.8 EXTRAS AND CREDITS

.1 Accompany all price submissions requested by Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:

- .1 Materials, quantities, and unit costs including any applicable contractors' trade discount clearly identified.
- .2 Labour hours and unit costs.
- .3 Total materials and labour costs.
- .4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

3.9 EQUIPMENT AND SYSTEM OPERATING AND MAINTENANCE DEMONSTRATION AND TRAINING

.1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.

.2 Instruct and familiarize Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.

.3 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.

.4 Ensure each instruction period includes but is not limited to the following.

- .1 A classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,
- .2 Instruction during the classroom seminar by the manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,
- .3 Demonstration of the proper operating procedures for each item of equipment,
- .4 Explanation of the purpose and function of all safety devices provided,
- .5 Demonstration of all measures required for safe and proper access for operation and maintenance.

.5 Provide a period of follow-up instruction on two occasions approximately one month after completing Owner's instruction to clarify and reinforce earlier instructions.

.6 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant before substantial completion of the project.

3.10 INTEGRATED TESTING

.1 Refer to Integrated Systems Plan provided with project specifications.

.2 The Contractor shall participate in integrated testing procedures and provide assistance to the Integrated Testing Coordinator for the successful completion of testing mechanical systems under Divisions 21, 22, 23 and 25 with fire protection and life safety functions in accordance with CAN/ULC-S1001 Integrated Systems Testing of Fire Protection and Life Safety Systems.

.3 Contractor shall repeat testing procedure until system has been successfully proven integrated.

.4 Integrated Systems Testing shall not be performed until all necessary documentation has been submitted to the Integrated Testing Coordinator.

.5 Where applicable systems to be tested include but are not limited to:
- .1 Fire Alarm Systems
- .2 Audio/Visual And/or Lighting Control Systems
- .3 Sprinkler and/or Standpipe Systems
- .4 HVAC Systems (BAS Connections, Prevention of Smoke Circulation, Fire and/or smoke closures, etc.)
- .5 Fixed Fire Suppression Systems
- .6 Cooking Equipment Fire Suppression Systems
- .7 Door Hardware (Hold-Open Devices, Electromagnetic Locks, etc.)
- .8 Smoke Control Systems
- .9 Emergency Lighting

.6 The process must be co-ordinated with the project construction schedule, suppliers, manufacturers, general contractor and sub-contractors with associated fire protection and life safety systems.

.7 The systems shall be tested as a whole system to verify interconnection between integrated systems. Testing must be completed once the complete fire protection and life safety system is installed. Individual component testing or partially installed assembly testing shall not be accepted.

.8 Submit signed testing reports to consultant upon completion.

.9 Integrated systems testing of fire protection and life safety systems testing shall be completed and associated documentation submitted to the consultant's approval prior to building occupancy.

.10 Include in O&M manuals, a periodic integrated systems testing schedule and an itemized list of integrated fire protection and life safety systems contained within the building for owner's future reference.

.11 Include a copy of the testing plan, testing forms, re-testing forms and testing report in O&M manuals.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 20 05 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 REFERENCE STANDARDS

.1 Provide all work in accordance with requirements of Regulatory Agencies and meet requirements of:
- .1 Local and district by-laws, regulations and published engineering standards.
- .2 Ontario Building Code as amended,
- .3 Ontario Gas Utilization Code as amended.
- .4 Regulations for Construction Projects under The Occupational Health and Safety Act.
- .5 Fire Code made under the Fire Marshal's Act.

.2 Meet requirements of the following CSA Standards:
- .1 CSA B242 Groove and Shoulder Type: Mechanical Pipe Couplings.
- .2 CSA W48 series Electrodes.
- .3 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .4 CSA B52 – Mechanical Refrigeration Code
- .5 CAN/CSA-W117.2, Safety in Welding, Cutting and Allied Processes
- .6 CAN1-B149.1 Natural gas and propane installation code.
- .7 CSA B64.1 Manual for the Selection and Installation of Backflow Prevention Devices
- .8 CSA B64.1 Manual for the Maintenance and Field Testing of Backflow Prevention Devices.

.3 Meet the requirements of the following National Research Council Canada publications:
- .1 National Building Code of Canada and Supplements to National Building Code of Canada
- .2 National Fire Code of Canada.
- .3 Canadian Plumbing Code.
- **.4** Model National Energy Code for Buildings

.4 Meet the requirements of the following American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) Standards:
- .1 ANSI/ASME B31.1 Power Piping.
- .2 ANSI/ASME B31.3, Process Piping.
- .3 ANSI/ASME Boiler and Pressure Vessel Code:
  - .1 Section 1: Power Boilers.
  - .2 Section V: Non-destructive Examination.
  - .3 Section IX: Welding and Brazing Qualifications.
- .4 ASME A13.1 - Scheme for the Identification of Piping Systems.
- .5 ASME B40.100 - Pressure Gauges and Gauge Attachments.

.5 Meet the requirements of the following American Welding Society (AWS) Standards:
- .1 AWS C1.1, Recommended Practices for Resistance Welding.
- .2 AWS Z49.1, Safety Welding, Cutting and Allied Process.
- .3 AWS W1, Welding Inspection.

.6 Meet the requirements of the following American Society for Testing and Materials (ASTM) Standards:
- .1 ASTM E1 - Specification for ASTM Thermometers.
- .2 ASTM E77 - Inspection and Verification of Thermometers.

.7 Meet the requirements of the following Underwriters Laboratories (UL) Standards:
- .1 UL 393 - Indicating Pressure Gauges for Fire-Protection Services.
- .2 UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

.8 Meet the requirements of the following National Fire Protection Association standards.
- .1 NFPA 10- Standard for Portable Fire Extinguishers

.9 Meet the requirements of AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

.10 Meet the requirements of AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

.11 Meet the requirements of IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

.12 Meet the requirements of NEMA MG 1 - Motors and Generators.
.13 Provide work where indicated in conformance with guide Specification of the Victaulic System for Building Services, G-100.
.14 The above documents or portions thereof are referenced within the work of Mechanical Divisions 21, 22 and 23 and shall be considered part of the requirements of this document as though fully repeated herein.

1.4 QUALIFICATIONS

.1 Motor manufacturer: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
.2 Firestop Sealant Manufacturer: Company specializing in manufacture of sealants with minimum three years documented product development, testing, and manufacturing experience.
.3 Firestop components and assemblies shall be ULC listed and tested in accordance with ULC S115 Standard Method of Fire Test for Firestop Systems.

1.5 SUBMITTALS

.1 Submit shop drawings in accordance with Section 20 01 01.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Transport, handle, store, and protect products. Refer to Division 01 requirements as well.
.2 Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.7 WASTE MANAGEMENT & DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 Waste Management and Disposal, and with the Contractor's Waste Reduction Workplan.
.2 Place materials defined as hazardous or toxic waste in designated containers.
.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.8 WARRANTY

.1 Provide extended coverage five-year warranty for motors larger than 20 HP (15 kW).

2 PRODUCTS

2.1 PIPING SPECIALTIES

.1 Cast brass, pressure, copper to copper unions shall be used with seamless copper tubing smaller than 3" (75 mm).
.2 Cast brass flanges shall be used with seamless copper tubing, type L for tubing 3" (75 mm) and larger.
.3 Dart type, 125 lb. (860 kPa) black malleable iron unions shall be used with all steel pipe for piping 2-1/2" (65 mm) and smaller.
.4 Slip-on, 150 lb. (1000 kPa) carbon steel flanges with 1/16" (4 mm) raised face shall be used with all steel pipe for piping larger than 2-1/2" (65 mm).
.5 Gaskets for joining flanged steel pipe shall be 1/16" (4 mm) Cranite ring type gaskets.
.6 Piping specialties including backflow preventers, strainers, valves etc. shall be line size unless indicated otherwise on drawings.
.7 Strainers
  .1 Manufacturers:
    .1 Sarco SB
    .2 Armstrong
    .3 Crane
    .4 Conbraco

.5 Colton
.6 Victaulic
.7 Or approved alternate

.2 In copper tubing: Class 250, wye type, bronze, screwed connection, with blind caps, and 1/32" (0.8 mm) perforated stainless steel screen.

.3 In Steel Piping: 2" (50mm) and smaller

.1 Body and cover: screwed, line size Y type strainer, semi-steel conforming to ASTM A278-85, Class 30, complete with screwed blind cap. Primary service rating of 175 psi @ 350 F (1207 kPa @ 178 C). Body shall have side drain connection.

.2 Screen: perforated type 304 stainless steel service:

.1	Steam	1/16" (0.4 mm)
.2	Water	1/32" (0.8 mm)
.3	Glycol	1/32" (0.8 mm)
.4	Water @ Pump Suction	1/8” (3.2 mm)
.5	Light Oil	1/16" (1.6 mm)
.6	Compressed Air	1/64" (0.4 mm)

.4 In Steel Piping: 2-1/2" (65mm) and larger

.1 Body and cover: flanged, line size Y type strainer, cast steel, class 150, complete with flanged blow down cover. Primary service rating of 175 psi @ 500 F (1207 kPa @ 260 C).

.2 Screen: perforated type 304 stainless steel service:

.1	Steam	1/32" (0.8 mm)
.2	Water	1/16" (1.6 mm)
.3	Glycol	1/16" (1.6 mm)
.4	Water @ Pump Suction	1/4” (6.4 mm)
.5	Light Oil	1/16" (1.6 mm)
.6	Compressed Air	1/32" (0.8 mm)

.5 In grooved piping-where permitted refer to 21, 22, 23 Piping Sections

.1 Victaulic Style 730 grooved end tee-type strainer for piping 2" (50 mm) and larger or approved equivalent.

.2 Victaulic Style 731 suction diffuser, Series 381/382 Vibration Isolation Pump Drop or approved equivalent.

2.2 ADHESIVES, SEALANTS, PAINTS AND COATINGS

.1 Adhesives, Sealants, Paints and Coatings: Use only low VOC emitting materials meeting following criteria:

.1 Paint for Mechanical Identification: maximum VOC emission of 250g/L
.2 Touch-Up Paint: maximum VOC emission of 250g/L
.3 Zinc-Rich Primer: maximum VOC emission of 250g/L
.4 Adhesives for Mechanical Identification: maximum VOC emission of 70g/L
.5 Sealants for service penetrations: maximum VOC emission of 650g/L clear and 350 g/L pigmented.
.6 Sealants for Firestopping: max. VOC emission of 650g/L clear and 350 g/L pigmented
.7 Acrylic Sealant for supports and anchors: maximum VOC emission of 250g/L
.8 Insulation Vapour Barrier Lap Adhesive: maximum VOC emission of 80g/L
.9 Insulation Joint Sealer: maximum VOC emission of 250g/L
.10 Insulation Vapour Barrier Mastic: maximum VOC emission of 400g/L
.11 Flame Retardant Adhesive: maximum VOC emission of 650g/L clear and 350 g/L pigmented.

2.3 WELDING ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

2.4 FIRESTOPPING COMPOUND

.1 Manufacturers:

.1 3M products indicated.

.2 Dow Corning
.3 John Manville
.4 Hilti Firestop Systems
.5 Or approved alternate

.2 Fire Rated Sealants: Intumescent material, synthetic elastomers, capable of expanding up to 8 to 10 times when exposed to temperatures of 250°F (121°C) or higher. ULC listed and labeled.

2.5 FIRE BARRIER PLASTIC PIPE DEVICE

.1 Manufacturers:
.1 3M PPD
.2 Hilti Firestop Systems
.3 Or approved alternate

.2 Description:
.1 One-piece metallic collar assembly with intumescent wrap strip material designed to firestop and smoke seal non-metallic penetrations in fire rated assemblies.
.2 Up to 6” non-metallic piping penetrating up to 2-hour fire rated assemblies.
.3 Tested to ASTM E814 (ANSI/UL 1479) and CAN/ULC-S115 Standard Method of Fire Tests for Through Penetration Fire Stops.

2.6 NAMEPLATES

.1 Provide laminated plastic plates with black face and white centre of minimum size 3-1/2" x 1-1/2" x 3/32" (90 x 40 x 2 mm) nominal thickness, engraved with 1/4" (6 mm) high lettering. Use 1" (25 mm) lettering for major equipment.

.2 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.

.3 Identify equipment type and number and service of areas or zone of building served.

.4 For each item of equipment which may be started automatically or remotely, add a red lamacoid plate, 2-1/2" x 9" (65 x 230 mm), reading: **"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME."**

2.7 TAGS

.1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 1-1/2" (40 mm) diameter. **OR**

.2 Metal Tags: Brass, aluminum, or stainless steel with stamped letters; tag size minimum 1-1/2" (40 mm) diameter with smooth edges.

.3 Chart: Typewritten letter size list in anodized aluminum frame.

2.8 STENCILS

.1 Stencils: With clean cut symbols and letters of following size:
.1 3/4"-1-1/4" (20-30 mm) Outside Diameter of Insulation or Pipe: 8" (200 mm) long colour field, 1/2" (15 mm) high letters.
.2 1-1/2"-2" (40-50 mm) Outside Diameter of Insulation or Pipe: 8" (200 mm) long colour field, 3/4" (20 mm) high letters.
.3 2-1/2"-6" (65-150 mm) Outside Diameter of Insulation or Pipe: 12" (300 mm) long colour field, 1-1/4" (30 mm) high letters.
.4 8" - 10" (200-250 mm) Outside Diameter of Insulation or Pipe: 24" (600 mm) long colour field, 2-1/2" (65 mm) high letters.
.5 Over 10" (250 mm) Outside Diameter of Insulation or Pipe: 32" (800 mm) long colour field, 3-1/2" (90 mm) high letters.
.6 Ductwork and Equipment: 2-1/2" (65 mm) high letters.

2.9 PRESSURE GAUGES

.1 Manufacturers:
  .1 Trerice Model 600BC.
  .2 Weiss
  .3 Winter
  .4 Morrison
  .5 Taylor
  .6 Or approved alternate
.2 Gauge: 4-1/2" (115mm) diameter black cast aluminum, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background, mid-scale accuracy: 1%, scale: psi and kPa.
.3 Gauge Cock: Tee or lever handle, brass for maximum 150 psi (1034 kPa).
.4 Needle Valve: Brass, 1/4" (6 mm) NPT for minimum 150 psi (1034 kPa).
.5 Pulsation Damper: Pressure snubber, brass with 1/4" (6 mm) connections.
.6 Syphon: Steel, Schedule 40, 1/4" (6 mm) angle or straight pattern.

2.10 STEM TYPE THERMOMETERS

.1 Manufacturers:
  .1 Trerice Model BX9 2 403.
  .2 Weiss Model 9VS3-1/2.
  .3 Winter
  .4 Morrison
  .5 Taylor
  .6 Or approved alternate
.2 Thermometer: 9" (230mm) scale, red appearing thermal fluid with black figures on white scale, calibrated in both degrees F and degrees C, accuracy to ASTM E77 of 2%, clear glass lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device, 3/4" (20mm) NPT brass stem.
.3 All thermometers to include a separable well.
.4 Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
.5 Flange: 3" (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.11 DIAL THERMOMETERS

.1 Manufacturers:
  .1 Trerice
  .2 Weiss.
  .3 Winter.
  .4 Morrison.
  .5 Taylor
  .6 Or approved alternate
.2 Thermometer: ASTM E1, stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
  .1 Size: 2" (50 mm) diameter dial.
  .2 Lens: Clear glass.
  .3 Accuracy: 1 percent.
  .4 Calibration: Degrees C Both Degrees F and degrees C.
.3 Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
.4 Flange: 3" (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.12 TEST PLUGS

.1 Manufacturers:
  .1 Pete's Plug.

.2 Watts TP.
.3 Or approved alternate

.2 Test Plug: 1/4" or 1/2" (6 mm or 15 mm) brass fitting and cap for receiving 1/8" (3 mm) outside diameter pressure or temperature probe with neoprene core for temperatures up to 93°C (200°F).

.3 Test Kit: Carrying case, internally padded and fitted containing one diameter pressure gauges, one gauge adapters with 1/8" (3 mm) probes, two 1" (25 mm) dial thermometers.

2.13 STATIC PRESSURE GAUGES

.1 Manufacturers:
.1 Trerice
.2 Weiss.
.3 Winter.
.4 Taylor.
.5 Or approved alternate

.2 3-1/2" (90 mm) diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full-scale accuracy.

.3 Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full-scale accuracy.

.4 Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4" (6 mm) diameter tubing.

2.14 ACCESS DOORS

.1 Manufacturers:
.1 Acudoor
.2 CEB
.3 MIFAB
.4 Cendrex Contour
.5 Or approved alternate

.2 Standard Universal Flush
.1 Material: Up to 16" x 16" (400x400) 16 Gauge mounting frame, over 16" x 16" (400x400) 14-gauge door, 16 gauge mounting frame.
.2 Hinge: Continuous, concealed.
.3 Latch: Stainless steel screwdriver operated cam latch
.4 Finish: Steel: 5-stage iron phosphate preparation with prime coat of white, Alkyd Baking Enamel
.5 Manufacturer Model: Acudoor UF-5000 General, Acudoor DW-5040 Drywall Walls, Acudoor BP58 Drywall Ceilings to match ceiling thickness, Acudoor DW-5040 Existing Drywall or approved alternate

.3 Recessed Access Door
.1 Material: Steel or stainless steel, 22-gauge door, 22 gauge mounting frame. Door-recessed 5/8"
.2 Hinge: Continuous, concealed.
.3 Latch: Stainless steel screwdriver operated cam latch
.4 Finish: Satin coat steel
.5 Manufacturers Model: Acudoor DW-5015 or approved alternate

.4 Fire Rated
.1 Access doors in fire separations or fire rated assemblies: ULC labelled. Refer to Architectural drawings for ratings of fire separations and assemblies. Minimum 20-gauge door, 16 gauge mounting frame.
.2 Hinge: Continuous, concealed.
.3 Latch: Stainless steel screwdriver operated cam latch
.4 Finish: Steel: 5-stage iron phosphate preparation with prime coat of white, Alkyd Baking Enamel
.5 Manufacturers Model: Acudoor FW-5050/FB-5060 to match fire separation or approved alternate

2.15 MOTOR CONSTRUCTION AND GENERAL REQUIREMENTS

.1 Motors less than 0.33 HP (250 W), for intermittent service may be equipment manufacturer's standard

and need not conform to these specifications.

.2 Electrical Service:
- .1 Motors 0.35 HP (0.38 kW) and Smaller: 115 volts, single phase, 60 Hz.
- .2 Motors Larger than 0.35 HP (0.38 kW): 575 volts, three phase, 60 Hz.

.3 Type:
- .1 Open drip-proof except where noted otherwise.
- .2 Design for continuous operation in 104°F (40°C) environment.
- .3 Design for temperature rise to NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- .4 Motors with frame sizes 254T and larger: NEMA premium efficiency.

.4 Motors smaller than 0.5 HP (372 W): Provide continuously rated squirrel cage induction type with capacitor start, EEMAC `N' starting characteristics and a minimum of Class `A' insulation.

.5 Motors 0.5 HP (372 W) and over: Provide continuously rated squirrel cage induction type with EMAC `B' starting characteristics and a minimum of Class `B' insulation.

.6 Provide drip-proof type motors with a 1.15 service factor, unless specified or required otherwise by the motor location.

.7 Provide fan cooled totally enclosed motors having a 1.0 service factor.

.8 Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.

.9 Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

.10 Wiring Terminations:
- .1 Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code, threaded for conduit.
- .2 For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

.11 Provide motors within the 1-500 horsepower range of the "high efficiency" or "premium efficiency" as required under provincial regulations. Ensure this is indicated on the motor nameplate. Provide "T" frame (NEMA Specifications) motors approved under the Ontario Electrical Safety Code. If delivery of specified motor shall delay delivery of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment shall not occur until the specified motor is installed.

.12 Coordinate with Division 26 the sizing of electrical protective devices supplying new and relocated mechanical equipment that contain integral motor starters and contactors.

.13 Motor ratings rated in watts refer to output watts.

.14 Provide constant speed motors with reduced voltage starters where specified.

.15 Motors for use with variable frequency drives shall be rated for invertor duty. Motors for pumps and fans shall be rated for inverter duty whether or not VFD are included at this time.

.16 Design BHP shall not exceed 80% of nominal motor HP.

2.16 SINGLE PHASE POWER - SPLIT PHASE MOTORS

.1 Starting Torque: Less than 150 percent of full load torque.

.2 Starting Current: Up to seven times full load current.

.3 Breakdown Torque: Approximately 200 percent of full load torque.

.4 Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated sleeve, or ball bearings.

.5 Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

2.17 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

.1 Starting Torque: Exceeding one fourth of full load torque.

.2 Starting Current: Up to six times full load current.

.3 Multiple Speed: Through tapped windings.

.4 Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, pre-lubricated sleeve or ball bearings, automatic reset overload protector.

2.18 SINGLE PHASE POWER - CAPACITOR START MOTORS

.1 Starting Torque: Three times full load torque.
.2 Starting Current: Less than five times full load current.
.3 Pull-up Torque: Up to 350 percent of full load torque.
.4 Breakdown Torque: Approximately 250 percent of full load torque.
.5 Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
.6 Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated sleeve bearings.
.7 Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

2.19 THREE PHASE POWER - SQUIRREL CAGE MOTORS

.1 Starting Torque: Between 1 and 1-1/2 times full load torque.
.2 Starting Current: Six times full load current.
.3 Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
.4 Design, Construction, Testing, and Performance: Meet the requirements of NEMA MG 1 for Design B motors.
.5 Insulation System: NEMA Class B or better.
.6 Testing Procedure: To IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
.7 Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
.8 Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.
.9 Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
.10 Sound Power Levels: To NEMA MG 1.
.11 Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
.12 Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
.13 Nominal Efficiency: As scheduled at full load and rated voltage when tested to IEEE 112.
.14 Nominal Power Factor: As scheduled at full load and rated voltage when tested to IEEE 112.

2.20 SLEEVES

.1 Materials: minimum schedule 20 galvanized steel or cast iron.

2.21 ESCUTCHEONS

.1 Finish: Polished chrome

2.22 FLASHINGS AND COUNTERFLASHINGS

.1 Thaler or approved equivalent mechanical/electrical flashings as recommended for specific purpose.
.2 Stainless steel flashing sleeve, integral deck flange and EPDM seal.

2.23 PENETRATION SEALS

.1 Manufacturer: Link-Seal or approved alternate
.2 Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the

annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut.

3 EXECUTION

3.1 INSPECTION

.1 Inspect installed work of other trades and verify that such work is complete to point where work under Mechanical Divisions 20, 21, 22, 23, 25 may properly begin.
.2 Verify that work of Mechanical Divisions 20, 21, 22, 23, 25 may be executed in accordance with pertinent codes and regulations, specifications, drawings, and referenced standards.
.3 Review drawings and verify dimensions at the site. Report discrepancies immediately to consultant before proceeding with any construction work or shop drawings.

3.2 PREPARATION

.1 Existing services and equipment shall be relocated or removed to suit new construction and renovation work.
.2 Services that are no longer required shall be removed or cut back and capped to the satisfaction of Consultant.
.3 Obtain written authorization from Consultant for renovation work that is not specifically indicated.
.4 Where modifications or connections to existing systems require shutdown of the system the Contractor shall submit a request for system shutdown describing the system or part to be shutdown, the duration of the shutdown, the work planned and steps to be taken to reinstate the system to full operation. The request shall be submitted in the format stipulated by the Owner.
.5 All work required to prepare systems for shutdown and/or re-instatement, such as draining, chemical treatments, and re-filling shall be included in this Bid Price.

3.3 PIPING INSTALLATION - ABOVE GROUND

.1 Cooperate with other trades whose work affects or is affected by work of Mechanical Sections, to ensure satisfactory installation and to avoid delays. Provide all materials to be built-in such as sleeves, anchors, etc., together with accurate dimensions or templates, promptly.
.2 Layout all work accurately, installing piping parallel to lines of building.
.3 Install piping, wherever possible, in partitions and above ceiling. Do not install piping in outside walls unless so shown on drawings. Wrap uninsulated piping in masonry walls with building paper.
.4 Install concealed piping close to building structure to minimize furring dimensions.
.5 Provide adequate space around piping to facilitate application of insulation.
.6 Use dielectric couplings where piping of dissimilar metals connects.
.7 Where piping passes through concrete floors, or walls, sleeves shall be sized to permit the pipe to expand freely without binding or crushing pipe insulation.
.8 Where branch pipes are welded into main without the use of "T" connections, torch cut openings must be cut true, beveled and filed smooth. Branch pipes must not be allowed to project inside of main pipe. Openings must not be cut large enough to permit entry of welding metal and slag within the pipe.
.9 Arrange all take-offs from mains to allow for expansion and contraction of pipes. Hot water branches serving down feed risers must be taken from lower sides or bottom of mains and grade down slightly to risers. Branches which serve units above the mains shall be taken from the top or sides of mains.
.10 When using PVC-DWV pipe, provide for expansion and contraction of risers by using ProSet E-Z Flex Coupling in accordance with good engineering practices.
.11 Install automatic control valves and wells supplied under other Sections of Mechanical Divisions.

3.4 PIPING JOINTS

.1 Make joints in piping installed under Mechanical Divisions using persons familiar with the particular materials being used and in accordance with CSA B51 and CSA B52, manufacturer's instructions, and as specified herein.
.2 Use only welder and/or brazer operators, with a valid identification card, as issued under The Boiler and Pressure Vessels Act, to make joints in Registered Piping Systems, as indicated under Section 20 01

01, and 20 05 00.

.3 Use 95/5 Sb.Sn (tin-antimony) solder for joining copper drainage tubing smaller than 4" (100 mm), and for joining copper water tubing installed above grade, and smaller than 4" (100 mm).

.4 Use silver solder or Silfos for joining copper tubing 4" (100 mm) and larger in size.

.5 Carefully ream joints in threaded pipe and paint with approved graphite type joint sealer on male connections only. Make connections with proper wrench to suit pipe size. Where leaks occur, the joint shall be disassembled and corrected if possible, or replaced. Over-tightening, caulking, or peening shall not be acceptable.

.6 Make joints in cast iron pipe with standard M-J joints in accordance with manufacturer's recommendations and CSA B70.

.7 When using Grooved Piping Method where permitted refer to 21, 22, 23 Piping Sections:

.1 Make joints in grooved piping with couplings and gaskets in accordance with Victaulic Company of Canada Ltd, General Catalogue 100, latest edition. Cut or roll grooves using tools specifically designed for that purpose.

.2 Use Zero-flex or rigidlok couplings in locations where rigidity is required, in particular in mechanical rooms on coils, headers and pumps.

.3 Vic-Boltless couplings may be used.

.4 Include in Bid Price Inspections by Victaulic or approved manufacturer

.5 Installers to be trained by Victaulic or approved manufacturer

.8 Install unions or welding flanges at connections to valves, etc. to facilitate removal.

.9 Use butt welding and/or schedule 40 carbon steel welding fittings to join sections of steel piping with welding ends.

3.5 WELDING

.1 Welder's Qualifications

.1 Welding qualifications to be in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction.

.3 Furnish welder's qualifications to Consultant and Owner.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

.2 Inspector's Qualifications: qualified to CSA W178.2

.3 Welding Procedures

.1 Registration of welding procedures in Procedures accordance with CSA B51.

.2 Copy of welding procedures to be available for inspection at all times.

.3 Safety in welding, cutting and allied processes to be in accordance with CAN/CSA-W117.2.

.4 Workmanship: Welding to be in accordance with ANSI/ASME B31.1 and B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, special procedures specified elsewhere in Division 23 applicable requirements of provincial authority having jurisdiction.

.5 Installation Requirements:

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

.6 Inspection and Testing:

.1 Hydrostatically test all welds to requirements of ANSI/ASME B31.1.

.2 Review all weld quality requirements and defect limits of applicable codes and standards with consultant before any work is started.

.3 Formulate "Inspection and Test Plan" in co-operation with consultant.

.4 Do not conceal welds until they have been inspected, tested, and approved by inspector.

.5 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Consultant, to ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.6 Visual examinations: include entire circumference of weld externally and wherever possible internally.
.7 Failure of visual examinations: on failure of any weld by visual examination, perform additional testing as directed by Consultant of a total of up to 25% of all welds, selected at random by Consultant, by particle tests.
.8 Inspect and test all welds in high pressure steam and high-pressure condensate piping in accordance with "Inspection and Test Plan" by magnetic particle (hereinafter referred to as "particle") tests.

.7 Defects Causing Rejection: as described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code, plus.
.1 Undercutting greater than 1/32" (0.8 mm) adjacent to cover bead on outside of pipe.
.2 Undercutting greater than 1/32" (0.8 mm) adjacent to root bead on inside of pipe.
.3 Undercutting greater than 1/32" (0.8 mm) at combination of internal surface and external surface.
.4 Incomplete penetration and incomplete fusion greater than total length of 1-1/2" (38 mm) 97% in any 6" (150 mm) length of weld depth of such defects being greater than 1/32" (0.8mm).
.5 Repair all cracks and defects in excess of 1/32" (0.8mm) in depth.
.6 Repair defects whose depth cannot be determined accurately on the basis of visual examination or particle tests.

.8 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.6 FLUSHING AND CLEANING

.1 Flush water mains in accordance with procedures established by NFPA 24
.2 Thoroughly flush all piping installed by Mechanical Divisions.
.3 Flush and sterilize domestic water mains in accordance with procedures established by AWWA Specification C601.
.4 Flush new domestic water piping in accordance with Local and Provincial Codes.
.5 Remove, clean, and replace all strainers in systems after flushing.
.6 Thoroughly clean all equipment and fixtures, and lubricate HVAC equipment, and leave all items in perfect order ready for operation.

3.7 PIPING SYSTEMS TESTING AND INSPECTION

.1 Before tests, isolate all equipment or other parts which are not designed to withstand test pressures.
.2 Test all piping at the completion of roughing-in, before connecting to existing systems, and before concealment, insulation or covering of piping.
.3 Make tests that are required by any authority having jurisdiction, in the presence of the authority's authorized inspector and shall be certified by him.
.4 Conduct tests in the presence of:
.1 Authorized inspector(s) for authorities having jurisdiction.
.2 The Owner's Representative
.3 The Consultant
.5 Notification must be given at least 48 hours in advance of tests being conducted, to all persons required to be present.
.6 Repair all leaks exposed during testing and retest. If defects in pipe or fittings are discovered in the system, they shall be removed and replaced.
.7 Certify tests not required by authorities having jurisdiction.

3.8 EQUIPMENT TESTING AND INSPECTION

.1 Test operation of equipment installed under Mechanical Divisions according to instructions in appropriate articles of Mechanical Specifications. Make any required adjustments or replacements to ensure equipment is operating as intended. Retest equipment requiring adjustment or replacement.
.2 Pay all fuel consumption charges for equipment under testing and during commissioning.
.3 Conduct tests before application of external insulation and before concealment of piping or ductwork.
.4 Arrange and pay for inspections by authorities as required by code and complete any changes or alterations required by such inspections.

.5 Conduct tests in the presence of:
.1 Authorized inspector(s) for authorities having jurisdiction.
.2 The Consultant.
.3 The Owner's Representative.
.6 Notification must be given at least 48 hours in advance of tests being conducted, to all persons required to be present.

3.9 TESTING AND BALANCING

.1 Refer to Section 20 05 93 – Testing, Adjusting and Balancing (TAB)
.2 Allow sufficient time for testing and verification before substantial completion. Notify Testing and Balancing Agency on completion of adjusting and balancing of systems.
.3 Adjust systems and components (drives, sheaves, belts, etc.) as required by Testing and Balancing Agency.
.4 Maintain systems in full operation during testing and verification.
.5 Make adjustments to control systems as required to facilitate verification. Maintain all safety controls in operation.
.6 Check and correct alignment of V-belts, drive shaft coupling drives, etc. as required by Testing and Balancing Agency.
.7 Provide pitot tube test fittings at all main branches of sheet metal work and at intake and discharge locations of air handling systems as required by Testing and Balancing Agency.

3.10 ELECTRICAL COMPONENTS AND WIRING

.1 Meet the requirements of Electrical Division 26 for all wiring included in Mechanical Divisions 20, 21, 22 and 23. Includes pre-wired equipment provided within appropriate Sections under Mechanical Divisions 20, 21, 22 and 23.
.2 Ensure that all pre-wired electrical equipment is CSA approved. Arrange and pay for special approval where this is not possible.
.3 Coordinate all wiring requirements with other Divisions. Line voltage wiring from power distribution panels to starters and from starters to motors shall be provided under Division 26. All the field wiring for equipment shall be included under Mechanical Divisions 21, 22 and 23, unless specifically called for under Division 25. Refer to Section 20 90 50 – Mechanical Electrical Equipment Schedule and Section 25 30 00 – Controls and Instrumentation

3.11 PROTECTION

.1 Protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under Mechanical Divisions.
.2 Repair to satisfaction of consultant, damage to building resulting from failure to provide such protection.
.3 All existing air intake and exhaust openings that may be affected by dust and/or debris from the construction work shall be fitted with appropriate filter media to protect against entry of dust and/or debris into the building and its air distribution systems. Filters shall be closely monitored and replaced when necessary. The Contractor shall replace existing filters that become contaminated with dust and/or debris from construction work with new filters.
.4 In the event that dust and debris from construction work does penetrate the building and/or its air distribution systems, the Contractor shall be responsible for cleaning the affected areas and/or systems.
.5 Temporary filters shall be removed on completion of the construction works.

3.12 CUTTING AND PATCHING

.1 Include cutting and patching as required in execution of work under respective Sections of this Mechanical Divisions.
.2 Holes through the structure shall not be permitted without written approval of the Consultant. Any and all openings required through the completed structure must be clearly and accurately shown on a copy of the relevant structural drawing(s). Exact locations, elevations and size of the proposed opening must be identified well in advance of the need for the work.
.3 All sleeved or formed openings through the structure must be shown on sleeving drawings and must be

approved by the Structural Consultant before construction.

.4 The Contractor shall conduct exploratory work including x-ray of the existing structure, shall mark the location of embedded reinforcements, anchors, conduits, and piping on exposed surfaces of adjacent floors and/or walls and shall pay all associated costs.

.5 Reinforcing shall not be cut or modified without prior approval of the Structural Consultant. Should reinforcement be cut without such prior approval, the cost of any additional reinforcement deemed necessary by the Structural Consultant shall be the responsibility of this Contractor.

.6 Alternative imaging techniques are subject to the approval of the Structural Consultant.

.7 Ensure that cutting and patching of roofs and reinforced concrete structures is executed by specialists familiar with the materials affected and is performed in a manner to neither damage nor endanger the work. Coordinate and supervise such cutting and patching.

.8 Maintain the integrity of fire rated assemblies where they are pierced by ducts and pipes.

.9 Make good surfaces affected by this work and repair finish to satisfaction of Consultant. Finish painting, where required, shall be provided under Division 09.

.10 Stop work immediately upon discovery of any hazardous material and report discovery to the Owner and Consultant. Obtain instruction before proceeding with the work.

3.13 EXCAVATING AND BACKFILLING

.1 Be responsible for excavation and backfilling necessary for installation of underground work under Mechanical Divisions.

.2 Excavate with suitable machinery or by hand as may be necessary and as follows:

- .1 Excavate to the depth and dimensions shown on drawings.
- .2 Keep excavation free of water by bailing, pumping or a system of drainage as required.
- .3 Cut and trim banks of excavation evenly, as nearly vertical as possible, and shore if required to prevent caving-in.
- .4 Keep bottom of excavation clean and clear of loose material. Slope or grade as required.
- .5 Provide shoring in accordance with The Occupational Health and Safety Act and Regulations for Construction Projects.
- .6 Notify Consultant immediately in case of encountering any unstable ground, unsuitable for bearing of pipes. Consultant shall decide the method of installation of pipes in unstable ground.
- .7 Inform Consultant immediately if the excavation reveals seepage zones, springs or other unexpected sub-surface conditions which may necessitate revisions to drainage or water supply systems.

.3 Obtain Consultant's approval before commencement of backfilling of trenches. Backfill the trenches carefully to prevent injury to the work and subsequent settlement and execute backfilling generally as follows:

- .1 Provide minimum 6" (150 mm) fine gravel or coarse sand bedding (Class B) or as indicated for the bottom of trenches.
- .2 Backfill above pipe bedding with granular material specified, hand tamp in layers of 6" (150 mm) thickness. Extend backfill 12" (300 mm) above pipe.
- .3 Backfill and consolidate remainder of trench depth below paved or graveled areas with granular Class "B" aggregate in 6" (150 mm) layers to an elevation to allow for thickness of Class "A" aggregate and asphalt pavement.
- .4 Backfill and consolidate reminder of trench depth below sodded or seeded areas with specified granular material or material obtained from site excavation where approved by consultant, in 9" (225 mm) layers to an elevation 6" (150 mm) below of proposed grades in sodded/seeded areas.
- .5 Compact each layer thoroughly at optimum moisture content with approved hand or mechanical tampers to a density equal to:
  - .1 95% of Maximum Standard Proctor Density
    - .1 Behind foundation and retaining walls on grades
    - .2 Below sodded or seeded areas.
  - .2 100% of Maximum Standard Proctor Density
    - .1 Below slabs on grade within building areas up to the underside of the crushed stone underlay
    - .2 Below paved or graveled areas

.6 Do not puddle or flood with water for consolidating backfill. Add Water during the compaction to optimum moisture content of backfilling material.

3.14 SEALANTS & CAULKING

.1 Fill voids around pipes:
- .1 Seal between sleeve and pipe in foundation walls and below grade floors with penetration seals (link-seal)). Install as per manufacturer's installation instructions.
- .2 Where sleeves pass through non-fire rated walls or floors, caulk space between pipe and sleeve with fibreglass. Seal space at each end with waterproof, fire retardant, non-hardening mastic.
- .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
- .4 Fill future-use sleeves with easily removable filler.
- .5 Coat exposed exterior surfaces or ferrous sleeves with heavy application of zinc rich paint (VOC content not to exceed 250 g/L).

.2 Temporarily plug all openings during construction.

3.15 FIRESTOPPING

.1 All openings in fire separations and fire rated assemblies for service penetrations shall be protected with ULC listed service penetration firestop systems (SP).

.2 The service penetration firestop system shall have F and FT ratings equal to or greater than ratings specified by the Architect for the fire separation (F) and firewall (FT) joint firestop systems (JF).

.3 All components employed in the service penetration firestop system shall meet the requirements of the ULC listing.

.4 Contractor shall prepare and submit a schedule of service penetration firestop systems to be employed indicating the ULC listing designation, services involved, location of opening through fire separation and the components of the fire separation assembly.

.5 Refer to architectural drawings for ratings of fire separations and assemblies.

3.16 SLEEVES

.1 Provide pipe sleeves at points where pipes pass through masonry or concrete.

.2 Provide sleeves of minimum schedule 20 galvanized steel or cast iron.

.3 Use cast iron or steel pipe sleeves with annular fin continuously welded at midpoint:
- .1 through foundation walls, with penetration seals.
- .2 through floors of mechanical rooms and equipment rooms.

.4 Provide 1/4" (6 mm) clearance all around, between sleeve and pipes or between sleeve and insulation.

.5 Where piping passes below footings, provide minimum clearance of 2" (50 mm) between sleeve and pipe. Backfill up to underside of footing with concrete of same strength as footing with concrete of same strength as footing.

.6 Terminate sleeves flush with surface of concrete and masonry and 2" (50 mm) above floors. Not applicable to concrete floors on grade.

.7 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction, caulk between sleeve recess and pipe, fasten roof flashing to clamp device, make water-tight durable joint. Coordinate with roofing Section.

3.17 CURBS

.8 Provide watertight concrete curb 4" (100 mm) high around mechanical services (pipes, ducts, conduits) which rise through mechanical (service) room floors. Make allowances for installation of ductwork and fire dampers where required. Provide minimum 4" (100 mm) clearance between openings for services within curbs. Ensure joint between curb and floor is watertight and maintains integrity of floor membrane where applicable.

3.17 EQUIPMENT BASES

.1 Supply and erect structural work required for installation of mechanical equipment.

.2 Build concrete bases 6" (150 mm) high, providing all necessary inserts, anchor bolts and other fasteners

required, for floor mounted tanks, heaters, pumps, air handlers, boilers, etc. Make concrete bases 6" (150 mm) larger all around than the base of the supported equipment and trowel finish to a neat smooth finish. Anchor equipment to pads using 8" (200 mm) cast-in-place anchor bolts. Ensure concrete supplied under this Division is 2500 psi (17 MPa) compressive strength after 28 days.

3.18 FLASHINGS

.1 Provide all flashing at each point where piping passes through the roof.
.2 Coordinate this work with the roofing Trades to ensure a satisfactory installation and to avoid delays.

3.19 ESCUTCHEONS AND PLATES

.1 Provide on pipes passing through finished walls, partitions, floors, and ceilings.
.2 Use chrome or nickel-plated brass, solid type with set screws for ceiling or wall mounting.
.3 Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.
.4 Where sleeve extends above finished floor, escutcheon or plates shall clear sleeve extension.
.5 Secure to pipe or finished surface, but not insulation.

3.20 SUPPORT AND ATTACHMENT

.1 Support and attach piping, ductwork fixtures and equipment from load bearing structures such as beams, joists, reinforced concrete slabs and concrete block walls, and do not support from or attach to steel roof deck and/or wall or ceiling finishes. Roof mounted mechanical equipment and services shall be anchored to the roof structure to resist both lateral and uplift wind forces in accordance with requirements of the Ontario Building Code. Refer to Section 20 05 30 – Supports and Anchors and Section 20 05 49 – Seismic Restraints.

3.21 PAINTING

.1 Repair minor damage to finish of equipment with standard factory applied baked enamel finish under the appropriate Sections of this division. Replace entirely, items suffering major damage to finish if too extensive to be repaired in the opinion of the Consultant.
.2 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.
.3 Ensure manufacturer’s identification labels are not painted over. Apply masking tape or paper cover to ensure identification labels do not receive field paint finish.

3.22 DISSIMILAR METALS

.1 Separate dissimilar metals in order to prevent galvanic corrosion.
.2 Provide gaskets or shims of approved materials to avoid electrolytic action.
.3 Use dielectric unions and/or flanges where piping of dissimilar metals are connected.

3.23 SERVICE CONNECTIONS

.1 Include in Bid Price all amounts required by utilities for service connections and /or modifications to service connection. Ensure amounts include fees, assessments, charges, etc., required in relation to service connection.

3.24 BELT DRIVES AND SHEAVES

.1 Provide belt driven equipment with V-belt drive, designed for at least 130 percent of motor nameplate horsepower rating and in accordance with manufacturer's recommendations for type of service intended. Ensure belt drives are at least 95 percent efficient. Balance and properly align drives. Provide matched sets of belts for multiple belt assemblies. Select belts to suit starting torque of driver. Do not use single belt drives only for motors larger than two horsepower.
.2 Provide motor sheaves for one and two belt drives of variable pitch type, with Dodge key adjustments. Supply two sets of fixed drive sheaves for drives with three or more belts. Install first set of fixed motor sheaves to obtain the originally specified rpm. After initial test and preliminary adjustment, supply and

install the second set of fixed sheaves if necessary, to provide the design flow quantities as established on the job. Obtain correct total flow rate for fans through speed changes and not by throttling.

.3 Provide adjustable sheaves on motor sizes up to 2 HP (1492 w) and fixed sheaves on larger motors.

3.25 GUARDS

.1 Provide OSHA compliant guards for exposed drives as follows:
- .1 Expanded metal screen (both sides) welded to 1" (25 mm) steel angle frame.
- .2 18 ga. 1" (25 mm) thick galvanized sheet metal tops and bottoms.
- .3 Removable sides for servicing.
- .4 1-1/2" (40 mm) dia. holes on both shaft centers for insertion of tachometer.

.2 Provide means to permit lubrication and use of test instruments with guards in place.

.3 Install belt guards to permit movement of motors for adjusting belt tension.

.4 For flexible couplings, provide removable, "U" shaped, 12 ga. 1/10" (2.7 mm) thick galvanized frame and 18 ga. 1/25" (1.2 mm) thick expanded mesh face.

.5 Provide 3/4" (20 mm) galvanized mesh wire screen on inlet or outlet of exposed fan blades such that net free area to openings is not less than 1.25 of original openings.

3.26 FIELD QUALITY CONTROL

.1 Temporary and Trial Usage
- .1 Allow the Owner the privilege of temporary and trial usage of installed equipment, as soon as work is complete, for a period of time required to conduct a thorough test.
- .2 Do not construe such usage as evidence of acceptance of work by Owner.
- .3 Repair damage to work tested, resulting from such trial usage, by this Contractor at no cost to Owner.

.2 Systems Verification:
- .1 Verify the correct installation and proper operation of equipment and systems installed. Adjust and balance each system as necessary to achieve optimum operation of each system.
- .2 Co-operate with the TAB agency as follows:
  - .1 Provide assistance when and as requested,
  - .2 Co-ordinate completion of work systematically to permit orderly verification and adherence to schedules,
  - .3 Provide additional necessary flow balancing devices as directed by agency,
  - .4 Notify TAB Agency of tests being conducted.

3.27 ADJUST AND CLEAN

.1 Clean equipment and fixtures, lubricate mechanical equipment installed under Mechanical Divisions and leave items in perfect order ready for operation.

.2 Test and adjust control devices, instrumentation, relief valves, dampers, etc., installed in Mechanical Divisions after cleaning of systems and leave in perfect order ready for operation.

.3 Remove from the premises upon completion of work of this division, debris, surplus, and waste materials resulting from operations.

3.28 MECHANICAL IDENTIFICATION INSTALLATION

.1 Degrease and clean surfaces to receive adhesive for identification materials.

.2 Prepare surfaces for stencil painting.

.3 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer (VOC content not to exceed 680 g/L).

.4 Install tags with corrosion resistant chain.

.5 Comply with standard detail drawing plate, "Detail of Piping Identification".

.6 Apply stencil markings on all covered piping.

.7 Apply stencil markings on all insulated and uninsulated ductwork in service spaces, coordinate labelling in occupied areas with Architect.

.8 Install plastic tape pipe markers complete around bare pipe to manufacturer's instructions.

.9 Label piping that is heat traced or equipped with heating cable "HEAT TRACED" in addition to other identification. Locate such labels adjacent to other identifications.
.10 Install underground plastic pipe markers 6"-8" (150-200 mm) below finished grade, directly above buried pipe.
.11 Identify pumps, water heating equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
.12 Identify control panels and major control components outside panels with plastic nameplates.
.13 Identify valves in main and branch piping with tags. Consecutively number valves in each system.
.14 Identify piping, concealed, or exposed, with stenciled painting **OR** plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20'-0" (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
.15 For each item of equipment which may be started automatically or remotely, add a red lamacoid plate, 2-3/8" x 9" (60 x 230 mm), reading: **"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED. IT MAY START AT ANY TIME."**
.16 Provide colour coded self-adhesive dots to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.29 MECHANICAL IDENTIFICATION SCHEDULES

.1 Consult the Owner and identify piping, ductwork and equipment as directed:
.1 Conforming to the Owner's existing identification practices, or
.2 Conforming to the following Pipe and Valve Identification Table based on ANSI/ASME 13.1:

SERVICE	COLOURS		MATERIAL PROPERTIES
	BACKGROUND	LETTERS	
Flammable or oxidizing	Yellow	Black	Fluids which are a vapour or produce vapors that can ignite and continue to burn in air
Combustible	Brown	White	Fluids that may burn but are not flammable
Toxic or Corrosive	Orange	Black	Fluids which are corrosive or toxic or will produce corrosive or toxic substances
Fire Quenching	Red	White	Water and other substances used in fire-fighting systems
Other Water	Green	White	Any other water, except for water used in fire-fighting systems
Compressed Air	Blue	White	Any vapour or gas under pressure that does not fit in a category above
Defined by User	Black	White	
Defined by User	Purple	White	
Defined by User	Grey	White	
Ductwork	Label all ductwork showing system type Supply, Return, and Exhaust system numbers		

3.30 MANUFACTURER'S NAMEPLATES

.1 Provide metal nameplates on each piece of equipment, mechanically fastened with raised or recessed letters.
.2 Include registration plates, Underwriters' Laboratories and CSA approval, as required by respective agency, and as specified. Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors, all factory supplied.
.3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

3.31 FLOW DIAGRAMS AND DIRECTORIES

.1 Provide Consultant with identification flow diagrams of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valves.
.2 Install where agreed with the Owner one copy of each flow diagram and valve schedule mounted in glazed frame. Provide one copy of each in Operation and Maintenance Manual.

3.32 INSTALLATION OF GAUGES AND THERMOMETERS

.1 Install to manufacturer's instructions.
.2 Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
.3 Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
.4 Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide syphon on gauges in steam systems. Extend nipples and syphons to allow clearance from insulation.
.5 Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-3/8" (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
.6 Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
.7 Adjust gauges and thermometers to final angle, clean windows, and lenses, and calibrate to zero.
.8 Locate test plugs adjacent thermometers and thermometer sockets.

3.33 INSTALLATION OF ACCESS DOORS

.1 Supply access doors for access to equipment requiring service, lubrication or adjustment and all concealed valves, control and volume dampers, and other such equipment.
.2 Turn over access doors to the appropriate general trade for installation under other Sections.
.3 Refer to architectural drawings for ratings of fire separations and assemblies. Install fire rated access doors in fire rated partitions, walls, and ceilings.
.4 Access doors in ceilings shall be minimum 24" x 24" (600mm x 600mm), unless otherwise approved by the Consultant.
.5 Provide access doors in GWB ceilings and coordinate in-fill with general trades.

3.34 MOTOR APPLICATIONS

.1 Single phase motors for shaft mounted fans: Split phase type.
.2 Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
.3 Single phase motors for fans: Capacitor starts type.
.4 Single phase motors for fans: Capacitor start, capacitor run type.
.5 Motors located in exterior locations: Totally enclosed type.
.6 Motors located in outdoors: Totally enclosed weatherproof epoxy-treated type.
.7 Motors located in outdoors: Totally enclosed weatherproof epoxy-sealed type.

3.35 INSTALLATION OF MOTORS

.1 Install motors to manufacturer's instructions.
.2 Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
.3 Check line voltage and phase and ensure agreement with nameplate.

3.36 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

HP	kW	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6 - 1/3	0.12-0.25	1.35	1.35	1.35	1.35
1/2	0.38	1.25	1.25	1.25	1.15
3/4	0.5	1.25	1.25	1.15	1.15
1	0.75	1.25	1.15	1.15	1.15
1/6 - 150	0.1-111	1.15	1.15	1.15	1.15

3.37 PERFORMANCE SCHEDULE: THREE PHASE - ENERGY EFFICIENT, OPEN DRIP-PROOF (ODP)

3 PHASE, ODP					
HP	**KW**	**RPM(Syn)**	**NEMA Frame**	**Minimum Efficiency %**	**Minimum Power Factor %**
1	0.75	1200	145T	81	72
1-1/2	1.1	1200	182T	84	73
2	1.5	1200	184T	85.5	75
3	2.25	1200	213T	86.5	60
5	3.7	1200	215T	87.5	65
7-1/2	5.6	1200	254T	89	73
10	7.5	1200	256T	90.2	74
15	11	1200	284T	90.2	77
20	15	1200	286T	91	78
25	18	1200	324T	91.7	74
30	22.5	1200	326T	92.4	78
40	30	1200	364T	93	77
50	37	1200	365T	93	79
60	45	1200	404T	93.6	82
75	56	1200	405T	93.6	80
100	75	1200	444T	94.1	80
125	93	1200	444T	94.1	84

3 PHASE, ODP					
HP	**KW**	**RPM(Syn)**	**NEMA Frame**	**Minimum Efficiency %**	**Minimum Power Factor %**

1	0.75	1800	143T	82.5	84
1-1/2	1.1	1800	145T	84	85
2	1.5	1800	145T	84	85
3	2.25	1800	182T	86.5	86
5	3.7	1800	184T	87.5	87
7-1/2	5.6	1800	213T	88.5	86
10	7.5	1800	215T	89.5	85
15	11	1800	256T	91	85
20	15	1800	256T	91	86
25	18	1800	284T	91.7	85
30	22.5	1800	286T	92.4	88
40	30	1800	324T	93	83
50	37	1800	326T	93	85
60	45	1800	364T	93.6	88
75	56	1800	365T	93.6	88
100	75	1800	404T	94.1	83
125	93	1800	405T	94.5	86
150	112	1800	444T	95	85
200	150	1800	445T	95	85

3 PHASE, ODP					
HP	**KW**	**RPM(Syn)**	**NEMA Frame**	**Minimum Efficiency %**	**Minimum Power Factor %**
1-1/2	1.1	3600	143T	82.5	85
2	1.5	3600	145T	84	87
3	2.25	3600	145T	84	85
5	3.7	3600	182T	85.5	86
7-1/2	5.6	3600	184T	87.5	88
10	7.5	3600	213T	88.5	86
15	11	3600	215T	89.5	89
20	15	3600	254T	90.2	89
25	18	3600	256T	91	92
30	22.5	3600	284T	91	91
40	30	3600	286T	92	92

50	37	3600	324T	93	89
60	45	3600	326T	93	91
75	56	3600	364T	93	88
100	75	3600	365T	93	88

3.38 PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED (TEFC)

3 PHASE, TEFC					
HP	**KW**	**RPM(Syn)**	**NEMA Frame**	**Minimum Efficiency %**	**Minimum Power Factor %**
1	0.75	1200	145T	81	72
1-1/2	1.1	1200	182T	85.5	73
2	1.5	1200	184T	86.5	75
3	2.25	1200	213T	87.5	60
5	3.7	1200	215T	87.5	65
7-1/2	5.6	1200	254T	89.5	73
10	7.5	1200	256T	89.5	74
15	11	1200	284T	90.2	77
20	15	1200	286T	90.2	78
25	18	1200	324T	91.7	74
30	22.5	1200	326T	91.7	78
40	30	1200	364T	93	77
50	37	1200	365T	93	79
60	45	1200	404T	93.6	82
75	56	1200	405T	93.6	80
100	75	1200	444T	94.1	80
125	93	1200	444T	94.1	84

3 PHASE, TEFC					
HP	**KW**	**RPM(Syn)**	**NEMA Frame**	**Minimum Efficiency %**	**Minimum Power Factor %**
1	0.75	1800	143T	82.5	84
1-1/2	1.1	1800	145T	84	85

2	1.5	1800	145T	84	85
3	2.25	1800	182T	87.5	86
5	3.7	1800	184T	87.5	87
7-1/2	5.6	1800	213T	88.5	86
10	7.5	1800	215T	89.5	85
15	11	1800	256T	91	85
20	15	1800	256T	91	86
25	18	1800	284T	91	85
30	22.5	1800	286T	92	88
40	30	1800	324T	92	83
50	37	1800	326T	93	85
60	45	1800	364T	93	88
75	56	1800	365T	93	88
100	75	1800	404T	93.6	83
125	93	1800	405T	94.5	86
150	112	1800	444T	94.5	85
200	150	1800	445T	95	85

3 PHASE, TEFC					
HP	**KW**	**RPM(Syn)**	**NEMA Frame**	**Minimum Efficiency %**	**Minimum Power Factor %**
1-1/2	1.1	3600	143T	82.5	85
2	1.5	3600	145T	84	87
3	2.25	3600	145T	85.5	85
5	3.7	3600	182T	87.5	86
7-1/2	5.6	3600	184T	88.5	88
10	7.5	3600	213T	89.5	86
15	11	3600	215T	90.2	89
20	15	3600	254T	90.2	89
25	18	3600	256T	91	92
30	22.5	3600	284T	91	91
40	30	3600	286T	92	92
50	37	3600	324T	93	89
60	45	3600	326T	93	91

75	56	3600	364T	93	88
100	75	3600	365T	93.6	88

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 20 05 16 applies to and govern all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Flexible pipe connectors.
.2 Expansion joints and compensators.
.3 Pipe loops, offsets, and swing joints.
.4 Anchors and guides

1.4 REFERENCES

.1 CSA B51 Boiler, Pressure Vessel, and Pressure Piping Code
.2 ASME B31.1 Code for Power Piping
.3 ASME B31.3 Process piping
.4 MIL-E-17814E - Expansion Joints, Pipe, Slip-Type, Packed.

1.5 PERFORMANCE REQUIREMENTS

.1 Provide structural work and equipment required to control expansion and contraction of piping.
.2 Verify that anchors, guides, and expansion joints provided, adequately protect system.
.3 Arrange all piping so that expansion and contraction of any piping may take place without placing undue strain on the piping or connections to the equipment. Use swing joints and suitable expansion joints wherever necessary due to field conditions and were indicated on the drawings.
.4 This Section shall analyze each section of pipe installed between constraints and shall determine the potential for expansion of the pipe based on pipe temperature at installation and pipe temperatures throughout the pipe's operating range. Where potential expansion exceeds 1" (25 mm) over the length of the pipe section, expansion compensators shall be installed. Pipe sections are constrained where they penetrate walls, partitions, floors, ceilings, roofs and movement of the pipe is restricted and where the pipe is anchored to the building structure.
.5 Expansion Calculations:
  .1 Safety Factory: 30 percent.
  .2 Installation Temperature: 50°F (10°C).
  .3 Hot Water Heating: 210°F (99°C).
  .4 Domestic Hot Water: 140°F (60°C).

1.6 SUBMITTALS

.1 Refer to Section 20 01 01.
.2 Product Data:
  .1 Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per metre and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  .2 Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
.3 Design Data: Submit detailed construction drawings for expansion compensation and piping anchors, signed and sealed by a professional engineer licenced in Ontario. Provide selection criteria used.
.4 Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
.2 Design expansion compensating system under direct supervision of a Professional Engineer experienced in design of this work and licenced in the Province of Ontario.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Transport, handle, store, and protect products.
.2 Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
.3 Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

.1 Warranty: 5-year replacement warranty.

1.10 EXTRA MATERIALS

.1 Section 20 01 01: Submittals for project closeout.
.2 Provide two 12-ounce (340 gm) containers of packing lubricant and cartridge style grease gun.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Manufacturers must be certified by the Expansion Joint Manufacturers Association (EJMA)
.2 Flexible Pipe Connectors
  .1 Flex-Pression Ltd.
  .2 Senior Flexonics
  .3 Ontario Hose
  .4 Colton Industries
  .5 Or approved alternate
.3 Expansion Joints
  .1 Flex-Pression Ltd.
  .2 Hyspan Precision Products, Inc.
  .3 Senior Flexonics
  .4 Or approved alternate
.4 Pipe Alignment Guides
  .1 Flex-Pression Ltd.
  .2 Hyspan Precision Products, Inc.
  .3 Senior Flexonics
  .4 Or approved alternate

2.2 PIPE ALIGNMENT GUIDES

.1 Steel Pipe:
  .1 Radial "spider" type, minimizing piping motions in non-axial planes.
  .2 Constructed of carbon steel with a 360-degree two-piece bolted housing, and 360-degree two-piece bolted clamps with spider type legs.
  .3 Provide an insulation clearance of 1.5" (37.5mm) on sizes 6" (150mm) IPS and under, and 2.0" (50mm) on sizes 8" IPS and over.
  .4 Axial travel shall be 3" (75mm) for sizes 2" (50mm) IPS and under, and 6" (150mm) for sizes 2-1/2" (65mm) IPS and over.
  .5 Refer to piping and expansion joint schedules for specific insulation and motion requirements.
  .6 Basis of design: Hyspan Series 9500.
.2 Copper Pipe:
  .1 Radial "spider" type, minimizing piping motions in non-axial planes.

.2 Constructed of carbon steel with non-metallic coating on the tube clamps, and a 360-degree two-piece bolted housing, and 360-degree two-piece bolted clamps with spider type legs.
.3 Provide an insulation clearance of 1.5" (37.5mm).
.4 Axial travel shall be 3" (75mm) for sizes 2-1/2" (65mm) and under, or 6" (150mm) for sizes 3" (75mm) and 4" (100mm).
.5 Refer to piping and expansion joint schedules for specific insulation and motion requirements.
.6 Basis of design: Hyspan Series 9500.

2.3 FLEXIBLE PIPE CONNECTORS

.1 Copper Piping:
.1 Inner Hose: Bronze
.2 Exterior Sleeve: Braided bronze.
.3 Pressure Rating: 125 psi (862 kPa) WSP and 450°F (232°C).
.4 Joint: As specified for pipe joints.
.5 Size: Use pipe sized units
.6 Maximum offset: 3/4" (20 mm) on each side of installed centre line.
.2 Steel Piping, 2" (50 mm) diameter and smaller:
.1 Inner Hose: braided bronze.
.2 Exterior Sleeve: None.
.3 Pressure Rating: 125 psi (862 kPa) WSP and 450°F (232°C).
.4 Joint: Threaded
.5 Size: Use pipe sized units.
.6 Maximum offset: 3/4" (20 mm) on each side of installed centre line.
.3 Steel Piping, 2-1/2" to 3-1/2" (65mm to 90mm) diameter:
.1 Inner Hose: braided bronze.
.2 Exterior Sleeve: None.
.3 Pressure Rating: 125 psi (862 kPa) WSP and 450°F (232°C).
.4 Joint: Flanged.
.5 Size: Use pipe sized units.
.6 Maximum offset: 3/4" (20 mm) on each side of installed centre line.
.4 Steel Piping, 4" (100mm) diameter and larger:
.1 Inner Hose: braided 321 stainless steel.
.2 Exterior Sleeve: None.
.3 Pressure Rating: 125 psi (862 kPa) WSP and 450°F (232°C).
.4 Joint: Flanged.
.5 Size: Use pipe sized units.
.6 Maximum offset: 3/4" (20 mm) on each side of installed centre line.

2.4 EXPANSION JOINTS - COPPER PIPING

.1 Bronze Bellows Type:
.1 Construction: 2-ply bronze with anti-torque device, limit stops, internal guides.
.2 Pressure Rating: 125 psi (862 kPa) WSP and 400°F (204°C).
.3 Maximum Compression: 1-3/4" (45 mm).
.4 Maximum Extension: 1/4" (6 mm).
.5 Joint: Soldered.
.6 Size: Use pipeline sized units
.7 Application: Copper piping.

2.5 EXPANSION JOINTS - DESIGN 150 PSIG / 500°F

.1 Ratings
.1 Design Pressure: 150 psig (1035 kPa)
.2 Test Pressure: 225 psig (1552 kPa)
.3 Design Temperature: 500 °F (260°C)
.2 Stainless Steel Bellows Type:
.1 Construction multi-ply ASTM A240 type 321 stainless steel bellows, ASME A53, Gr. B carbon

steel housing,
.2 Pressure Rating: 150 psi (1035 kPa) WSP and 500°F (260°C).
.3 Maximum Compression: 1-3/4" (45 mm).
.4 Maximum Extension: 1/4" (6 mm).
.5 Joint: Flanged.
.6 Size: Use pipeline sized units
.7 Application: Steel piping 2-1/2" (65 mm) and smaller.

.3 Externally Pressurized:
.1 Construction: Self-equalizing type with three or four ply ASTM A240 type 321 stainless steel bellows; ASME A53, Grade B carbon steel housing and pipe nipples; ASME-A36 steel plate guide rings and flanges; ASME A105, 3000-lb thread-o-let drain port & plug.
.2 Pressure Rating: 300 psi (2070 kPa) WOG and 500°F (260°C).
.3 Maximum Compression: 8" (200 mm).
.4 Maximum Extension: 2" (50 mm).
.5 Joints: Flanged.
.6 Size: Use pipeline sized units
.7 Application: Steel piping 3" (75 mm) and larger.

2.6 LAMINATED, ULTRA-LOW PRESSURE FORCE

.1 Size 1-1/2”-4”
.1 Ratings:
.1 Design Pressure: 150 PSIG 300 PSIG
.2 Test Pressure: 225 PSIG 450 PSIG
.3 Maximum Temperature: 500 °F.
.4 Basis of design: Hyspan series 1501-1506.

Pipe Size	Effective Area (In^2)	Pipe Size	Effective Area (In^2)
1-1/2”	2.3	6”	33.3
2”	4.1	8”	56.8
2-1/2”	5.8	10”	87.2
3”	8.8	12”	122.0
4”	15.4	14”	152.0

.2 Size 4”-12”
.1 Ratings:
.1 Design Pressure: 150 PSIG
.2 Test Pressure: 225 PSIG
.3 Maximum Temperature: 500 °F.
.4 Basis of design: Hyspan series 1501/1502 HYRISER.

Pipe Size	Effective Area (In^2)	Axial Spring Rate (lbs/in)
4”	15.4	155
5”	23.5	190
6”	33.3	348
8”	56.8	325
10”	87.2	411
12”	122.0	614

.3 Expansion joints shall be low area, three-ply, internally pressurized designs, single or dual configurations as scheduled.

.4 Integral pipe attachments must have a radius where the bellows neck is received.
.5 Expansion joints with larger effective area, welded to the pipe OD, not of three plies, or attached to a pipe without a radius shall not be accepted.
.6 Bellows shall be three ply, type 304 or 321 stainless steel, with the effective areas listed below, and attached to the pipe ID. Alloy 625 bellows shall be provided when chloride-ion, stress-corrosion cracking is a concern.
.7 Internal liners of stainless steel shall remain within the joint over all dimensions under design motions and self-drain.
.8 Bellows receivers of A53 Gr. B (or A106 Gr. B) standard weight pipe, with internal radii.
.9 Flanges shall be A36 carbon steel plate, or A105 forged, with ANSI B16.5 drilling and outside diameter. Flanges may be fixed or lap joint stub end.
.10 Butt weld ends of schedule standard A53 Gr. B (or A106 Gr. B).
.11 Dual joints must include an intermediate anchor base.
.12 Warranty required: 5-Year limited.

2.7 TIED UNIVERSAL EXPANSION JOINTS

.1 Ratings:
.1 Design Pressure: 50, 150, or 300 PSIG
.2 Test Pressure: 75, 225, or 450 PSIG
.3 Lateral Motions: 2", 3", 4"
.4 Maximum Temperature 500 °F.
.2 Expansion Joints shall be the tied universal configuration incorporating two independent bellows. The expansion joint shall be installed perpendicular to the piping run inducing lateral motion. The expansion joint induces only spring forces to the piping when only lateral motions are absorbed.
.3 Bellows shall be one-to-four plies as required of austenitic stainless steel.
.4 Flanges shall be A36 carbon steel plate, with ANSI B16.5 drilling and outside diameter. Flanges may be fixed, or van stone as indicated on the schedule. Carbon steel van stone flanges allow slight rotation for misalignment and/or to allow *stainless steel wetted surfaces for corrosion resistance.
.5 Butt weld-ends shall be schedule standard A53 Gr. B, or the schedule and material grade otherwise indicated.
.6 Tie/Limit rods are required to absorb pressure thrust forces and provide safety limits for design motions.
.7 Internal liners shall be provided for:
.1 liquid flows at 10 feet per second or higher in pipes 6" IPS and over,
.2 flows exceeding 2 feet per second per inch of diameter in pipes under 6" diameter,
.3 flow rates exceeding 100 feet per second.
.4 steam service,
.5 abrasive flows.
.8 Tied Universal expansion joints shall be Hyspan series 1511R flanged or 1512R weld end.

2.8 EXTERNALLY PRESSURIZED & LAMINATED EXPANSION JOINT

.1 Ratings:
.1 Design Pressure 150 - 300 PSIG
.2 Test Pressure 225 - 450 PSIG
.3 Maximum Temperature 500 °F.
.2 Expansion joints shall be externally pressurized, with internal and external guides.
.3 Bellows must be three plies with the specified effective areas and attached via independent collars.
.4 Materials of construction are A-53 Gr. B (or A-106 Gr.B) standard weight liner and housing, carbon steel guide rings, and type 304 stainless steel bellows with the effective areas listed below. Attach the bellows to internal and external guide rings via 304 S.S. collars. Use Alloy 625 bellows when chloride-ion, stress-corrosion cracking is a concern.
.5 Bellows welded to guide rings at the root or crest radii are not acceptable.
.6 Vent internal guide rings to reduce the effects of sudden pressure changes.
.7 Include a lifting lug and drain port.
.8 Flanges shall be A36 carbon steel plate, or A105 forged, with ANSI B16.5 drilling and outside

diameter. Flanges may be fixed or lap joint stub end.

.9 Butt weld ends of schedule standard A53 Gr. B (or A106 Gr. B).

.10 Dual joints must include an intermediate anchor base.

.11 Design basis: Hyspan series 3501-3506 or approved alternate

Pipe Size	Effective Area (in^2)	Pipe Size	Effective Area (in^2)
1-1/2”	8.2	6”	50.3
2”	8.2	8”	80.5
2-1/2”	10.6	10”	115
3”	13.7	12”	164
4”	22.7	14”	206
5”	35.3	16”	258

2.9 EXTERNALLY PRESSURIZED & LAMINATED

.1 Ratings:

.1 Design Pressure: 200 PSIG

.2 Test Pressure: 300 PSIG

.3 Maximum Temperature: 500 °F

.4 Axial Compression: 2" or 3"

.2 Expansion compensators shall be externally pressurized, with internal and external guides. The Expansion Joint Manufacturers Association (EJMA) must certify the manufacturer. Bellows must be two plies minimum with the specified effective areas.

.3 Materials of construction for steel piping compensators are:

.1 Butt weld, male pipe thread and steel groove ends with integral liner are schedule standard A53 Grade B, carbon steel housing and guide rings, and *304 s/s or 321 s/s bellows with the effective areas listed below. Flanges, if specified, are provided fixed with ANSI B16.5 drilling and outside diameter. Attach bellows necks to internal and external guide rings. Bellows welded to guide rings at the convolution root or crest radii are not acceptable. **Use Alloy 625 bellows when chloride-ion, stress-corrosion cracking is a concern.*

.4 Materials of construction for copper tube compensators are:

.1 Type L copper tube ends male or female sweat, 304 s/s housing and guide rings, *304 or 321 s/s bellows with the effective areas listed below. Attach the bellows necks to internal and external guide rings. Bellows welded to guide rings at the convolution root or crest radii are not acceptable.

.5 Expansion compensators shall be Hyspan series 8500, or other engineer approved equal.

Steel Pipe Size	Effective Area (in^2)	Copper Tube Size	Effective Area (in^2)
3/4”	1.5	3/4”	1.1
1”	2.1	1”	1.7
1-1/4”	3.3	1-1/4”	2.4
1-1/2”	4.3	1-1/2”	3.2
2”	6.3	2”	5.1
2-1/2”	8.8	2-1/2”	7.6
3”	13.1	3”	10.6
4”	20.8	4”	17.9

2.10 PRESSURE BALANCED, EXTERNALLY PRESSURIZED, LAMINATED

.1 Ratings:
  .1 Design Pressure 150 300 PSIG
  .2 Test Pressure 225 450 PSIG
  .3 Maximum Temperature 500 °F.
.2 Expansion joints pressure balanced, externally pressurized, laminated bellows type, with internal and external guides.
.3 Bellows shall be three plies with specified spring rates per Hyspan catalog 574H and attached via independent collars.
.4 Materials of construction are A-53 Gr. B (or A-106 Gr. B) standard weight liner and housing, carbon steel guide rings, and type 304 stainless steel bellows with three plies. Attach the bellows to internal and external guide rings via 304 S.S. collars. Use Alloy 625 bellows when chloride-ion, stress-corrosion cracking is a concern.
.5 Bellows welded to guide rings at the root or crest radii are not acceptable.
.6 Vent internal guide rings to reduce the effects of sudden pressure changes.
.7 Include a lifting lug and drain port.
.8 Flanges shall be A36 carbon steel plate, or A105 forged, with ANSI B16.5 drilling and outside diameter. Flanges may be fixed or lap joint stub end.
.9 Butt weld ends of schedule standard A53 Gr. B (or A106 Gr. B).
.10 Dual joints must include an intermediate anchor base.
.11 Design basis: Hyspan series 3500PB.

2.11 SLIP EXPANSION JOINT

.1 Expansion joints shall be packed-slip type containing injectable flaked graphite packing and graphite seals. Packing ports allowing packing under full line pressure are required. Non-injectable packing designs are not acceptable. Non-graphite packing and seals are not acceptable.
.2 Internal and external line-bore machined guides of ASTM SB169-C614. Non-ASME rated bearing materials are not acceptable. Joint Seal Force is 850 pounds per inch of diameter or less in published catalog.
.3 A stainless-steel extension limit stop ring covering approximately 360 degrees shall be included on each slip tube. Limit-stop pins are not acceptable.
.4 The slip tube shall be made from A53-Gr. B pipe, schedule 80 from 1-1/4" through 16" IPS and schedule 60 from 18" through 24" IPS sizes. The slip tube shall be hard-chromed-plated .002" thick according to ASTM B650.
.5 One-piece body required.
.6 Include a drain port on each joint.
.7 See the expansion joint schedule for required weld end fittings of schedule standard, schedule 40 or schedule 80, or flanges.
.8 Joint design and manufacturing in compliance with ASTM F1007 and MIL-E-17814F.
.9 Expansion joints shall be Hyspan Series 6500 Perma-Pax or approved alternate

Nominal Size (NPS)	Effective Area (in^2)	Joint Seal Force (lbs)
2	4	1700
2-1/2	5.9	2125
3	8.9	2550
4	15	3400
5	23.2	4250
6	32.5	5100
8	55.9	6800

10	86.6	8500
12	123	10,200
14	148	11,900
16	195	13,600
18	247	15,300
20	306	17,000
24	443	20,400

2.12 BALL JOINTS

.1 Hyspan-Barco Type N Series I Ball Joints
- .1 Angular motion of plus and minus 7.5 degrees and torsional motion of 360 degrees
- .2 Ball, Case and Bolting Retainer of carbon steel - stronger than schedule standard pipe of equivalent size.
- .3 Bolted Retainer Ball Joints allowing field tightening/adjustment of bearing/seals and unbolting replacement of bearing/seals via bolt removal. Cutting and re-welding of ball joint case for bearing/seal removal and replacement shall not be accepted.
- .4 Ball hard-chromed-plated .002" thick according to ASTM B650.
- .5 Bearing seals of composite phenolic material not requiring field lubrication
- .6 Design basis: Hyspan series 6500

.2 Hyspan-Barco Type N Series II Ball Joints
- .1 Angular motion of plus and minus 7.5 degrees and torsional motion of 360 degrees
- .2 Ball, Case and Bolting Retainer of carbon steel - stronger than schedule standard pipe of equivalent size.
- .3 Bolted Retainer Ball Joints allowing field tightening/adjustment of bearing/seals and unbolting replacement of bearing/seals via bolt removal. Cutting and rewelding of ball joint case for bearing/seal removal and replacement shall not be accepted. Injectable graphite secondary seal shall be included.
- .4 Flake graphite packing injected, plugged, and tested at the factory.
- .5 Ball hard-chromed-plated .002" thick according to ASTM B650.
- .6 Bearing seals of ductile iron, composite phenolic, Inconel or other factory clarified material.
- .7 Design basis: Hyspan series 6500

2.13 HIGH PERFORMANCE TYPE N BALL JOINTS

.1 Design Conditions:
- .1 Design Pressure: 1500 psig
- .2 Test Pressure: 1500 psig
- .3 Design Temperature: 650°F

.2 Description: flanged, bolted retainer type with high nickel stainless steel seals and integral recharge cylinders designed for injection of asbestos-free pure flaked graphite sealant and shall be capable of sealing without the use of additional bypass containment seals. Injectors shall include an integral stainless steel shut off valve for injection of sealant under full continuous operating conditions of the system. Ball joints shall provide 360° of rotation and 15° total angular flex.

.3 Materials and Construction:
- .1 All pressure containing parts and bolting shall be designed and manufactured from materials conforming to code requirements of ASME Section II and ANSI/ASME B31.1
- .2 Carbon steel ball spheres shall be plated with 2 mils of chrome consisting of 1 mil hard chrome over 1 mil of crack-free chrome. The chrome plating shall be protected by a baked-on molybdenum disulfide coating.
- .3 Ball joint pipe connection ends shall be beveled for welding to standard wall pipe (unless otherwise specified) or with ANSI forged steel weld neck flanges.

.4 Acceptance Testing:

.1 All flexible ball joints shall be hydrostatically tested at one-and-one half times design pressure.
.2 Each ball joint shall be pressurized with 50 psig saturated steam, or thermal equivalent, inspected for leakage and have bolts properly torqued before shipment.
.3 Ball joints shall be capable of certification to Mil-Std 167 vibration test and Mil-S-901 shock test.

.5 Design basis: Hyspan-Barco Style III High Performance Type N ball joints **or** Hyspan-Barco Style III High Performance Type N ball joints with Type V Injectors

2.14 FLEXIBLE PIPE LOOP EXPANSION

.1 Manufacturers:
.1 Flex Hose Co
.2 FHC-International
.3 Anvil-Star

.2 TRI-FLEX LOOP
.1 Models TFL2/4SMN (male NPT ends), Models TFL2/4SMP (150# plate steel flanges) constructions to be 3 equal length sections of annular corrugated 321 / 304L stainless steel close-pitch hose with stainless steel over-braid that shall absorb or compensate for pipe movements in all 6 degrees of freedom (3 coordinate axes, plus rotation about those axes) simultaneously.
.2 The corrugated metal hose, braid(s), and a stainless-steel ring-ferrule/band (material gauge not less than .048") must be integrally seal welded using a 100% circumferential, full penetration TIG welds. End fittings shall be selected per application. Fittings must be attached using a 100% circumferential TIG weld.
.3 Braided stainless steel Tri-Flex Loops must be suitable for operating temperatures up to 850 degrees F (455 degrees C). Braided bronze Tri-Flex Loops must be suitable for operating temperatures up to 400 degrees F (204 degrees C).
.4 Tri-Flex Loop must be designed for pressure testing to 1.5 times their maximum rated working pressure and a minimum 4:1 (burst to working) safety factor.
.5 Each braided Tri-Flex Loop shall be individually leak tested by the manufacturer using air-under-water and/or hydrostatic pressure.
.6 Tri-Flex Loops shall be prepared for shipment using a cut-to-length metal shipping bar, tacked securely between the elbows of the two parallel legs, to maintain the manufactured length during shipping. Shipping bar must be removed prior to system start-up.
.7 The manufacturer’s Tri-Flex hanger assembly kit shall be used to support and hang the Tri-Flex Loop.
.8 For seismic classification buildings the ULC Listed Seismic Wire/Cable assemblies conform to the Structural Seismic Engineer requirements for structural applications of wire rope, in that the cable is pre-stretched and the permanent end fittings maintain the break strength of the cable with a safety factor of two.
.9 The pre-manufactured flexible loop shall be installed and guided following the manufacturer's published installation instructions.
.10 The pre-manufactured flexible loop design shall be tested by an independent third party to confirm simultaneous movement in X, Y, and Z planes plus rotation about those axes. Third party testing shall document and confirm motion capabilities of the device. Device testing to include large and irregular movements similar to movement that may be caused by seismic movement analytically using finite element modeling and computer simulation as well as physical testing of the device. Independent third party testing data and documentation are to be furnished upon the engineers request during pre-qualification process or at the time of submission.
.11 The pre-manufactured flexible loop shall meet the requirements of the 2009 International Building Code (IBC) and the American Society of Civil Engineers code requirements for Total Maximum Displacement and accidental torsion as directed in IBC Chapter 13 and ASCE 7-05, Chapter 17.1.2.

.3 Warranty
.1 Tri-Flex Loop must have a 5-year full replacement warranty when installed in accordance with all specifications and installation instructions as described in the Flex-Hose Tri-Flex Loop

Installation and Maintenance Instructions.

3 EXECUTION

3.1 INSTALLATION

.1 Install flexible pipe connectors and expansion joints to manufacturer's instructions.

.2 Ratings and bolt patterns for flanges shall suit design pressure and design temperature of piping system and match those of installed components.

.3 Construct spool pieces to exact size of flexible connection for future insertion.

.4 Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

.5 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

.6 Pipe anchors shall be installed securing the piping system to the building structure in to control the direction and the amount of pipe movement. In addition, pipe anchors shall be installed to prevent separation of pipe due to hydraulic pressures. Pipe anchors shall be designed by the Contractor to accommodate all forces experienced. Prepare calculations for each anchor and submit to consultant for review and approval. Provide pipe guides so movement is directed along axis of pipe only. Not less than two guides shall be provided on each side of an expansion joint. Erect piping such that strain and weight is not on cast connections or apparatus.

.7 Provide support and equipment required to control expansion and contraction of piping. Provide pipe offsets, and swing joints, or expansion joints where required. The Contractor may elect to install expansion loops in place of expansion compensators where there is adequate space to do so, subject to the approval of the Consultant. The Contractor shall prepare and submit detailed design calculations for each expansion loop proposed to the Consultant for review and approval before installation.

3.2 MANUFACTURER'S FIELD SERVICES

.1 Prepare and start systems to Section 20 01 01.

.2 Provide inspection services by manufacturer's representative for final installing and certify installation is to manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 20 05 30 applies to and govern all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Pipe and equipment hangers and support.
.2 Equipment bases and supports.
.3 Sleeves and seals.
.4 Flashing and sealing equipment and pipe stacks.

1.4 REFERENCES

.1 ASME B31.1 - Power Piping.
.2 ASME B31.2 - Fuel Gas Piping.
.3 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
.4 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
.5 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
.6 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
.7 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
.8 NFPA 13 - Installation of Sprinkler Systems.
.9 NFPA 14 - Installation of Standpipe, Private Hydrants, and Hose Systems.
.10 UL 203 - Pipe Hanger Equipment for Fire protection Service.

1.5 SUBMITTALS

.1 Section 20 01 01: Procedures for submittals.
.2 Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
.3 Product Data: Provide manufacturers catalogue data including load capacity.
.4 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
.5 Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.6 REGULATORY REQUIREMENTS

.1 Meet the requirements of CSA B-51 for support of piping.

2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

.1 Manufacturers:
  .1 Anvil
  .2 Myatt
  .3 Cooper B-Line
  .4 Unistrut
  .5 Erico
  .6 Or approved alternate
.2 Hydronic Piping:
  .1 Meet the requirements of CSA B-51 and ASME B31.9.
  .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
  .3 Hangers for Cold Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
  .4 Hangers for Hot Pipe Sizes 2" to 4" (50 to 100 mm): Carbon steel, adjustable, clevis.
  .5 Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable steel yoke, cast iron roll,

double hanger.
.6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
.7 Multiple or Trapeze Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
.8 Wall Support for Pipe Sizes to 3" (76 mm): Cast iron hook.
.9 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
.10 Wall Support for Hot Pipe Sizes 6" (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
.11 Vertical Support: Steel riser clamp.
.12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
.13 Floor Support for Hot Pipe Sizes to 4" (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
.14 Floor Support for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
.15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.3 Refrigerant Piping:
.1 Meet the requirements of ASME B31.5.
.2 Hangers for Pipe Sizes 1/2" to 1-1/2" (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
.3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
.5 Wall Support for Pipe Sizes to 3" (75 mm): Cast iron hook.
.6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
.7 Vertical Support: Steel riser clamp.
.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.4 Plumbing Piping:
.1 Refer to 22 14 13.

2.2 DUCT HANGERS

.1 Refer to Section 23 31 00 Ductwork.

2.3 ACCESSORIES

.1 Hanger Rods: galvanized, carbon steel continuous threaded.
.2 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 ROOFTOP PIPE/DUCT SUPPORTS

.1 Manufacturers:
.1 Portable Pipe Hangers, Inc.
.2 Thaler
.3 Bigfoot
.4 ASP Advanced Support Products
.5 Eco Foot DXS
.6 Unistrut-Unipier
.7 Or approved alternate

.2 Pre-engineered pipe/duct support system including:
.1 Bases: weather resistant and UV radiation resistant with seismic attachments
.2 Framing: 1-5/8" (41.3mm) strut or 1-7/8" (47.6mm) strut, fabricated of steel to ASTM A570, Grade 33, roll formed of 12-gauge (2.7mm thick) steel into 3-sided or tubular shape.
.3 Pipe Supports and Hangers: Meet the requirements of MSS SP-58 and MSS SP-69,

fabricated of carbon steel. Single roller supports for piping subject to expansion and contraction.

.4 Finishes:
  .1 Plastics as moulded with UV radiation protection.
  .2 Metal surfaces hot dip galvanized free of roughness, whiskers, unsightly spangles, icicles, runs, barbs, sags, droplets, and other surface blemishes. Galvanizing shall meet the requirements of ASTM A123 for tubing and to ASTM A153 for hardware and accessories.

.5 Shop Drawings: Manufacturer to provide detailed shop drawings to indicate layout and supporting capacities of system components with installation and assembly instructions for each application. Shop drawings shall bear the signature and seal of a professional engineer licensed in Ontario.

3 EXECUTION

3.1 INSTALLATION

.1 Install to manufacturer's instructions.

3.2 INSERTS

.1 Provide inserts for placement in concrete formwork.
.2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
.3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4" (100 mm).
.4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
.5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.3 PIPE HANGERS AND SUPPORTS

.1 Support horizontal piping as scheduled.
.2 Install hangers to provide minimum 1/2" (13 mm) space between finished covering and adjacent work.
.3 Place hangers within 12" (300 mm) of each horizontal elbow.
.4 Use hangers with 1-1/2" (38 mm) minimum vertical adjustment.
.5 Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.
.6 Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
.8 Support riser piping independently of connected horizontal piping.
.9 Provide copper plated hangers and supports for copper piping.
.10 Design hangers for pipe movement without disengagement of supported pipe.
.11 Prime coat exposed steel hangers and supports. Refer to Section 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

.1 Provide housekeeping pads of concrete, minimum 6" (150 mm) thick and extending 6" (150 mm) beyond supported equipment. Refer to 20 01 01 and 20 05 00.
.2 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
.3 Construct supports of steel members. Steel pipe and fittings. Brace and fasten with flanges bolted to structure.
.4 Provide rigid anchors for pipes after vibration isolation components are installed.

3.4 ROOFTOP PIPE/DUCT SUPPORT

.1 Coordinate installation of supports and bases with roofing work. Ensure that roofing surfaces are

smooth and flat and are ready to receive work.

.2 Use care in installation of support systems not to damage roofing, flashing, equipment, or related materials.

.3 Install and secure support systems in strict accordance with manufacturer's written instruction.

.4 Consult manufacturers of roofing system to determine if walk pads are required. Provide and fully adhere walk pads to roof system where required.

.5 Bases and support framing shall be located as indicated on shop drawings provided by support system manufacturer and as specified herein. The support of all piping shall be complete and adequate, whether or not all required devices are shown.

.6 The use of wood or wire for supporting piping shall not be permitted.

.7 Deflection of pipes shall not exceed 1/240th of the span.

.8 Accurately locate and align bases. Where applicable, replace gravel around bases. Set framing posts into bases and assemble framing structure as indicated.

.9 Use galvanized fasteners for galvanized framing and use stainless steel fasteners for stainless steel framing.

3.5 FLASHING

.1 Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

.2 Flash vent and soil pipes projecting 6" (150 mm) minimum above finished roof surface with lead worked 1" (25 mm) minimum into hub, 8" (200 mm) minimum clear on sides with 24" x 24" (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter flash, and seal.

.3 Flash floor drains in floors with topping over finished areas, 10" (250 mm) clear on sides with minimum 36" x 36" (910 x 910 mm) sheet size. Fasten flashing to drain clamp device.

.4 Seal roof, floor, shower, and mop sink drains watertight to adjacent materials.

.5 Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed to manufacturer's instructions for sound control.

.6 Provide curbs for mechanical roof installations 14" (350 mm) minimum high above roofing surface. Flash and counter flash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

.7 Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

.1 Set sleeves in position in formwork. Provide reinforcing around sleeves.

.2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

.3 Extend sleeves through floors 1" (25 mm) above finished floor level. Caulk sleeves.

.4 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

.5 Install chrome plated steel escutcheons at finished surfaces.

3.7 SCHEDULES

.1 Imperial Measure (IP)

Pipe Size (in)	Rod Diameter (in)	Support Spacing (Ft)	
		Steel Pipe	Copper Tube
1/2	3/8	7	6
¾	3/8	7	6
1	3/8	7	6

1-1/4	3/8	7	6
1-1/2	3/8	9	8
2	3/8	10	9
2-1/2	3/8	12	10
3	3/8	12	10
4	5/8	14	12
6	7/8	17	
8	7/8	19	
10	7/8	21	
12	7/8	23	
14	1	25	
16	1	27	
18	1	28	

.2 Metric Measure (SI)

Pipe Size (mm)	Rod Diameter (mm)	Support Spacing (m)	
		Steel Pipe	Copper Tube
13	10	2.1	1.8
20	10	2.1	1.8
25	10	2.1	1.8
32	10	2.1	1.8
38	10	2.7	2.4
50	10	3	2.7
65	10	3.6	3
75	10	3.6	3
100	16	4.2	3.6
150	22	17	
200	22	5.7	
250	22	6.4	
300	22	7	

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 20 05 48 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Vibration control of piping, ductwork, and equipment.
.2 Inertia bases.
.3 Coordination with Section 20 05 30 Supports and Anchors
.4 Coordination with Section 20 05 49 Seismic Restraints

1.4 REFERENCES

.1 Ontario Building Code.
.2 SMACNA "HVAC Duct Construction Standards"
.3 ASHRAE
.4 VISCMA

1.5 PERFORMANCE REQUIREMENTS

.1 Provide vibration isolation on motor driven equipment over (1/2 HP), plus connected piping and ductwork.
.2 Provide minimum static deflection of isolators for equipment as indicated.
    .1 Basement, Under 15 kW
        .1 Under 400 rpm: RIS
        .2 400 - 600 rpm: 1" (25 mm)
        .3 600 - 800 rpm: 1/2" (12 mm)
        .4 800 - 900 rpm: 1/4" (5 mm)
        .5 1100 - 1500 rpm: 1/8" (4 mm)
        .6 Over 1500 rpm: 1/8" (3 mm)
    .2 Basement, over 15 kW
        .1 Under 400 rpm: RIS
        .2 400 - 600 rpm: 2" (50 mm)
        .3 600 - 800 rpm: 1" (25 mm)
        .4 800 - 900 rpm: 1/2" (12 mm)
        .5 1100 - 1500 rpm: 1/4" (5 mm)
        .6 Over 1500 rpm: 1/8" (4 mm)
    .3 Upper Floors, Normal
        .1 Under 400 rpm: 1-1/2" (40 mm)
        .2 400 - 600 rpm: 3-1/2" (90 mm)
        .3 600 - 800 rpm: 2" (50 mm)
        .4 800 - 900 rpm: 1" (25 mm)
        .5 1100 - 1500 rpm: 1/2" (12 mm)
        .6 Over 1500 rpm: 1/4" (5 mm)
    .4 Upper Floors, Critical
        .1 Under 400 rpm: 1-1/2" (40 mm)
        .2 400 - 600 rpm: 2" (50 mm)
        .3 600 - 800 rpm: 3-1/2" (90 mm)
        .4 800 - 900 rpm: 2" (50 mm)
        .5 1100 - 1500 rpm: 1" (25 mm)
        .6 Over 1500 rpm: 1/2" (12 mm)

.3 Consider upper floor locations critical unless otherwise indicated.
.4 Use concrete inertia bases for fans having static pressure in excess of 3.4 IN. WG (0.85 kPa) or motors in excess of 40 HP (30 kW), and on base mounted pumps over 10 HP (7.5 kW).
.5 Provide seismic restraints in accordance with Ontario Building Code requirements for Post Disaster Buildings. Seismic restraints shall be designed, installed, and reviewed under the direct supervision of a professional engineer licensed in the Province of Ontario.

1.6 SUBMITTALS

.1 Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.
.2 Product Data: Provide schedule of vibration isolator type with location and load on each.
.3 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
.4 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Manufacturer shall be a member of VISCMA.
.2 Coordinate selection of Manufacturer with Section.
.3 Acceptable manufacturers:
  .1 Swegon (Vibro Acoustics)
  .2 VAW
  .3 The VMC Group (Korfund-Masdom)
  .4 Mason Industries
  .5 Kinetics Noise Control/Vibron
  .6 Or acceptable equivalent

2.2 VIBRATION ISOLATORS

.1 Isolators and bases shall be as tabulated on the equipment schedule.
.2 Type 1 Isolators: Model KIP Pre-compressed Molded Fiberglass Noise and Vibration Isolation Pads, individually coated with a flexible moisture-impervious elastomeric membrane. Pads shall be fine (0.00027"/6.9-micron diameter) bonded annealed glass fibers which have been stabilized during manufacture by compressing the material ten times. Pads shall have a constant natural frequency over the operating load range, and the stiffness shall increase proportionately with load applied. Pads shall be no taller than the shortest horizontal dimension. Where the equipment base does not provide a uniform load surface, steel plates shall be bonded to the top of the pads. Alternatively, Model RD Neoprene Mounts, incorporating completely enclosed metal inserts to permit bolting to the supported unit, may be used.
.3 Type 2 Floor Isolators: Model FDS Free-Standing, Unhoused, Laterally Stable Steel Springs incorporating levelling bolts and 1/4 in. (6 mm) thick ribbed noise isolation pads. To assure stability, the spring shall have a lateral spring stiffness greater than 1.0 times the rated vertical stiffness and shall be designed to provide 50% overload capacity. In capacities up to 5,000 lbs. (2268 kg), springs shall be replaceable. In capacities over 5,000 lbs. (2268 kg), springs shall be welded to the top and bottom load plate assemblies.
.4 Type 2 Hangers: Model SFH Combination Spring and Fiberglass Hangers, incorporating pre-compressed moulded fiberglass noise and vibration isolation pads, coated with a moisture impervious elastomeric membrane in series with springs, all encased in welded steel brackets. Springs shall be as specified above. Isolators shall be designed to accommodate rod misalignment over a 30-degree arc. Brackets shall be designed to carry 500% overload without failure.
.5 Type 3 Isolators: Model FLS, Free-Standing, Laterally Stable, Spring Isolators, similar to Type FDS, but incorporating vertical limit stops to assure a constant operating height if the supported weight is removed, and to reduce movement due to wind loads. Limit stops shall be isolated from the housing to prevent short-circuiting.
.6 Type 4 Bases: No base required. Isolators may be attached directly to the supported equipment.

.7 Type 5 or 6 Bases: Model SFB or SBB Structural Steel Bases, designed and supplied by the isolator manufacturer. Bases shall be designed with isolator brackets to reduce the mounting height of the equipment. To assure adequate stiffness, the height of the members shall be a minimum of 8% of the longest span between isolators, or at least 6 inches (152 mm). Where thinner sections are necessary due to head room limitations, etc., the section modulus of the members selected shall equal or exceed the section modulus of wide flange steel members whose thickness is 8% of the longest span between isolators.

.8 Type 7 Bases: Model CIB Reinforced Concrete Inertia Bases, the steel members of which are designed and supplied by the isolator manufacturer. The concrete shall be poured into a welded steel frame, incorporating pre-located equipment anchor bolts, 1/2 in. (13 mm) diameter reinforcing bars on nominal 8 in. (203 mm) centers each way, and recessed isolator mounting brackets to reduce the mounting height of the equipment, but yet remain within the confines of the base. The thickness of the base shall be a minimum of 8% of the longest span between isolators, at least 6 inches (152 mm), or as indicated on the drawings. Where inertia bases are used to mount pumps, the bases shall be large enough to support piping elbows.

.9 Type 8 Bases: Model KSR, KSCR or ESR Isolation Rail System, consisting of two parallel rail systems, incorporating steel spring isolators designed for the specified static deflection, all fabricated to be installed as a part of the roof curb system, and provide continuous support for the isolated equipment.

.10 Piping: All piping 1 in. (25 mm) diameter and over in the mechanical equipment room, and all piping three supports away from other mechanical equipment shall be isolated from the structure by means of vibration and noise control isolators. Suspended piping shall be isolated with Type 2 Hangers as described above. Floor-mounted piping shall be isolated with Type 2 Spring Isolators as described above.

.11 Flexible members shall be incorporated in the ductwork adjacent to all reciprocating equipment and shall be approved construction.

.12 Flexible connections shall be incorporated in the ductwork adjacent to all air-moving units. The connections shall be neoprene or canvas of approved construction. High pressure ductwork, for a distance of 50 feet (1270 mm) from high pressure fans shall be isolated from the ductwork by means of Type 2 Hangers as described above.

.13 Three flexible type grooved joint couplings may be used in lieu of flexible connectors at equipment connections in applicable piping systems. The couplings shall be placed in close proximity to the vibration source. Basis of Design: Victaulic Company.

3 EXECUTION

3.1 INSTALLATION

.1 Install to manufacturer's instructions.

.2 Install isolation for motor driven equipment.

.3 Bases:

- .1 Set steel bases for 1" (25 mm) clearance between housekeeping pad and base.
- .2 Set concrete inertia bases for 2" (50 mm) clearance between housekeeping pad and base.
- .3 Adjust equipment level.

.4 Install spring hangers without binding.

.5 On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

.6 Before making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

.7 Provide pairs of horizontal limit springs on fans with more than (6.0 in wg) static pressure, and on hanger supported, horizontally mounted axial fans.

.8 Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.06" (1.5 mm) maximum clearance. Provide other snubbers with clearance between 1/8" and 1/4" (4 mm and 7 mm).

.9 Support piping connections to isolated equipment resiliently as follows:

- .1 Up to 4" (100 mm) Diameter: First three points of support.

.2 5" to 8" (125 to 200 mm) Diameter: First four points of support.
.3 10" (250 mm) Diameter and Over: First six points of support.
.4 Select three hangers closest to vibration source for minimum 1" (25 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1" (25 mm) static deflection or 1/2 static deflection of isolated equipment.

.10 Connect wiring to isolated equipment with flexible hanging loop.

3.2 MANUFACTURER'S FIELD SERVICES

.1 Inspect isolated equipment after installation and submit report. Include static deflections.

3.3 VIBRATION ISOLATOR SELECTIONS

.1 Refer to attached Schedule, based on Kinetics Vibron Selection Guide.
.2 Copied with permission.

EQUIPMENT ITEM				GRADE SUPPORTED SLAB			UP TO 20 FT. (6 M) FLOOR SPAN			20-30 FT. (6-9 M) FLOOR SPAN			30-40 FT. (9-12 M) FLOOR SPAN			
Taken from Kinetics Selection Guide		Horsepower and Other (Shaft Power, kW and Other)	RPM	BASE TYPE	ISOLATOR TYPE	MIN. DEFLECTION IN. (MM)	BASE TYPE	ISOLATOR TYPE	MIN. DEFLECTION IN. (MM)	BASE TYPE	ISOLATOR TYPE	MIN. DEFLECTION IN. (MM)	BASE TYPE	ISOLATOR TYPE	MIN. DEFLECTION IN. (MM)	REF. NOTES
REFRIGATION MACHINES AND CHILLERS	Reciprocating	All	All	A	2	025 (6)	A	4	0.75 (19)	A	4	1.50 (38)	A	4	2.50 (64)	2,3,12
	Centrifugal, Scroll	All	All	A	1	025 (6)	A	4	0.75 (19)	A	4	1.50 (38)	A	4	1.50 (38)	2,3,4, 8,12
	Screw	All	All	A	1	1.00 (25)	A	4	1.50 (38)	A	4	2.50 (64)	A	4	2.50 (64)	2,3,4, 12
	Absorption	All	All	A	1	025 (6)	A	4	0.75 (19)	A	4	1.50 (38)	A	4	1.50 (38)	--
	Air-Cooled Recip., Scroll	All	All	A	2	0.25 (6)	A	4	1.50 (38)	A	4	1.50 (38)	A	4	2.50 (64)	2,4,5, 12
	Air-Cooled Scroll	All	All	A	4	1.00 (25)	B	4	1.50 (38)	B	4	2.50 (64)	B	4	2.50 (64)	2,4,5, 12
AIR COMPRESSORS AND VACUUM PUMPS	Tank-Mounted Horizontal	up to 10 (7.5)	All	A	3	0.75 (19)	A	3	0.75 (19)	A	3	1.50 (38)	A	3	1.50 (38)	3,15
		15 (11) and over	All	C	3	0.75 (19)	A	3	0.75 (19)	C	3	1.50 (38)	C	3	1.50 (38)	3,15
	Tank-Mounted Vertical	All	All	C	3	0.75 (19)	A	3	0.75 (19)	C	3	1.50 (38)	C	3	1.50 (38)	3,15
	Base-Mounted	All	All	C	3	0.75 (19)	A	3	0.75 (19)	C	3	1.50 (38)	C	3	1.50 (38)	3,14,15
	Large Reciprocating	All	All	C	3	0.75 (19)	A	3	0.75 (19)	C	3	1.50 (38)	C	3	1.50 (38)	3,14,15
PUMPS	Close Coupled	up to 7.5 (5.6)	All	B	2	0.25 (6)	C	3	0.75 (19)	C	3	0.75 (19)	C	3	0.75 (19)	16
		10 (7.5) and over	All	C	3	0.75 (19)	C	3	0.75 (19)	C	3	1.50 (38)	C	3	1.50 (38)	16
	In Line	5 to 25 (3.7 to 19)	All	A	3	0.75 (19)	A	3	1.50 (38)	A	3	1.50 (38)	A	3	1.50 (38)	--
		30 (22) and over	All	A	3	1.50 (38)	A	3	1.50 (38)	A	3	1.50 (38)	A	3	2.50 (64)	--
	End Suction and Double Suction/ Split Case	up to 40 (30)	All	C	3	0.75 (19)	C	3	0.75 (19)	C	3	1.50 (38)	C	3	1.50 (38)	16
		50 to 125 (37 to93)	All	C	3	0.75 (19)	C	3	0.75 (19)	C	3	1.50 (38)	C	3	2.50 (64)	10,16
		150 (110) and over	All	C	3	0.75 (19)	C	3	1.50 (38)	C	3	2.50 (64)	C	3	3.50 (89)	10,16
	Packaged Pump Systems	All	All	A	3	0.75 (19)	A	3	0.75 (19)	A	3	1.50 (38)	C	3	2.50 (64)	--
COOLING TOWERS	Cooling Towers	All	up to 300	A	1	0.25 (6)	A	4	3.50 (89)	A	4	3.50 (89)	A	4	3.50 (89)	5,8,18
			301 to 500	A	1	0.25 (6)	A	4	2.50 (64)	A	4	2.50 (64)	A	4	2.50 (64)	5,18
			500 and over	A	1	0.25 (6)	A	4	0.75 (19)	A	4	0.75 (19)	A	4	1.50 (38)	5,18
BOILERS	Fire-Tube	All	All	A	1	0.25 (6)	B	4	0.75 (19)	B	4	1.50 (38)	B	4	2.50 (64)	4
	Water-Tube, Copper Fin	All	All	A	1	0.12 (3)	A	1	0.12 (3)	A	1	0.12 (3)	B	4	0.25 (6)	--

AXIAL FLOW FANS, PLENUM FANS, CABINET FANS, FAN SECTIONS, CENTRIFUGAL INLINE FANS	up to 22"Ø	All	All	A	2	0.25 (6)	A	3	0.75 (19)	A	3	0.75 (19)	C	3	0.75 (19)	4,8,9
	24"Ø & over	up to 2" (500 Pa) static pressure	up to 300	B	3	2.50 (64)	C	3	3.50 (89)	C	3	3.50 (89)	C	3	3.50 (89)	8,9
			301 to 500	B	3	0.75 (19)	C	3	1.50 (38)	C	3	2.50 (64)	C	3	2.50 (64)	8,9
			501 and over	B	3	0.75 (19)	B	3	1.50 (38)	B	3	1.50 (38)	B	3	1.50 (38)	8,9
		2.1 (501 Pa) static pressure and over	up to 300	C	3	2.50 (64)	C	3	3.50 (89)	C	3	3.50 (89)	C	3	3.50 (89)	3,8,9
			301 to 500	C	3	1.50 (38)	C	3	1.50 (38)	C	3	2.50 (64)	C	3	2.50 (64)	3,8,9
			501 and over	C	3	0.75 (19)	C	3	1.50 (38)	C	3	1.50 (38)	C	3	2.50 (64)	3,8,9
CENTRIFUGAL FANS	up to 22"Ø	All	All	B	2	0.25 (6)	B	3	0.75 (19)	B	3	0.75 (19)	B	3	1.50 (38)	9,19
	24"Ø & over	up to 40 (30)	up to 300	B	3	2.50 (64)	B	3	3.50 (89)	B	3	3.50 (89)	B	3	3.50 (89)	8,19
			301 to 500	B	3	1.50 (38)	B	3	1.50 (38)	B	3	2.50 (64)	B	3	2.50 (64)	8,19
			501 and over	B	3	0.75 (19)	B	3	0.75 (19)	B	3	0.75 (19)	B	3	1.50 (38)	8,19
		50 (37) and over	up to 300	C	3	2.50 (64)	C	3	3.50 (89)	C	3	3.50 (89)	C	3	3.50 (89)	2,3,8, 9,19
			301 to 500	C	3	1.50 (38)	C	3	1.50 (38)	C	3	2.50 (64)	C	3	2.50 (64)	2,3,8, 9,19
			501 and over	C	3	1.00 (25)	C	3	1.50 (38)	C	3	1.50 (38)	C	3	2.50 (64)	2,3,8, 9,19
PROPELLER FANS	Wall-Mounted	All	All	A	1	0.25 (6)	A	1	0.25 (6)	A	1	0.25 (6)	A	1	0.25 (6)	--
	Roof Exhauster	All	All	C	1	0.25 (6)	B	1	0.25 (6)	B	4	1.50 (38)	D	4	1.50 (38)	--
HEAT PUMPS, FAN COILS, COMPUTER ROOM UNITS	All	All	All	A	3	0.75 (19)	A	3	0.75 (19)	A	3	0.75 (19)	AD	3	1.50 (38)	--
CONDENSING UNITS	All	All	All	A	1	0.25 (6)	A	4	0.75 (19)	A	4	1.50 (38)	AD	4	1.50 (38)	--
AH, AC AND H & V UNITS	All	up to 10 (7.5)	All	A	3	0.75 (19)	A	3	0.75 (19)	A	3	0.75 (19)	A	3	0.75 (19)	19
		15 (11) and over, up to 4" (1 kPa) static pressure	up to 300	A	3	0.75 (19)	A	3	3.50 (89)	A	3	3.50 (89)	C	3	3.50 (89)	2,4,8, 19
			301 to 500	A	3	0.75 (19)	A	3	2.50 (64)	A	3	2.50 (64)	A	3	2.50 (64)	4,19
			501 and over	A	3	0.75 (19)	A	3	1.50 (38)	A	3	1.50 (38)	A	3	1.50 (38)	4,19
		15 (11) and over, 4" (1 kPa) static pressure and over	up to 300	B	3	0.75 (19)	C	3	3.50 (89)	C	3	3.50 (89)	C	3	3.50 (89)	2,3,4, 8,9

			301 to 500	B	3	0.75 (19)	C	3	1.50 (38)	C	3	2.50 (64)	C	3	2.50 (64)	2,3,4, 9
			501 and over	B	3	0.75 (19)	C	3	1.50 (38)	C	3	1.50 (38)	C	3	2.50 (64)	2,3,4, 9
PACKAGED ROOFTOP EQUIPMENT	All	All	All	AD	1	0.25 (6)	D	3	0.75 (19)							5,6,8, 17
DUCTED ROTATING EQUIPMENT	Small Fans, Fan-Powered Boxes	up to 600 cfm		A	3	0.50 (13)	A	3	0.50 (13)	A	3	0.50 (13)	A	3	0.50 (13)	7
		600 cfm and over		A	3	0.75 (19)	A	3	0.75 (19)	A	3	0.75 (19)	A	3	0.75 (19)	7
ENGINE DRIVEN GENERATORS	All	All	All	A	3	0.75 (19)	C	3	1.50 (38)	C	3	2.50 (64)	C	3	3.50 (89)	2,3,4

Notes:

1	Isolator deflections shown are based on reasonably expected floor stiffness according to floor span and class of equipment. Certain spaces may dictate higher levels of isolation. For example, bar joist roofs may require a static deflection of 38mm over factories, but 64mm over commercial office buildings
2	For large equipment capable of generating substantial vibratory forces and structure borne noise, increase isolator deflection, if necessary, so isolator stiffness is less than one-tenth the stiffness of the supporting structure, as defined by the deflection due to load at the equipment support.
3	For noisy equipment adjoining or near noise-sensitive areas, see the section on Mechanical Room Sound Isolation
4	Contain designs cannot be installed directly on individual isolators (type A), and the equipment manufacturer or a vibration specialist should be consulted on the need for supplemental support (base type)
5	Wind load conditions must be considered. Restraint can be achieved with restrained spring isolators (type 4), supplemental bracing, snubbers, or limit stops
6	Certain types of equipment require a curb-mounted-base (type D). Airborne noise must be considered.
7	See section on Resilient Pipe Hangars and Supports for hangar locations adjoining equipment in equipment rooms.
8	To avoid isolator resonance problems, select isolator deflection so that resonance frequency is 40% or less of the lowest normal operating speed of equipment (see chapter 8 in the 2009 ASHRAE Handbook Fundamentals). Some equipment, such as variable frequency drives, and high speed equipment such as screw chillers and vane axial fans, contain very high frequency vibration. This equipment creates new technical challenges in the isolation of high frequency noise and vibration from a building`s structure. Structural resonances both internal and external to the isolators can significantly degrade their performance at high frequencies. Unfortunately, at present no test standards exists for measuring the high frequency dynamic properties of isolators, and commercially available products are not tested to determine their effectiveness for high frequencies. To reduce the chance of high frequency vibration transmission, add a 25mm thick pad (type 1, Note 20) to the base plate of spring isolators (type 3, Note 22, 23, 24). For some sensitive locations, air springs (Note 25) may be required. If equipment is located near extremely noise sensitive areas, follow the recommendations of an acoustic consultant.
9	To limit undesirable movement, thrust restraints (type 5) are required for all ceiling-suspended and floor mounted units operating at 1500 Pa or more total static pressure.
10	Pumps over 55 KW may need extra mass and restraints
11	
12	Refrigeration Machines: Large centrifugal, screw and reciprocating refrigeration machinery may generate very high noise levels, special attention is required when such equipment is installed in upper-storey locations or near noise-sensitive areas. If equipment is located near extremely noise sensitive areas, follow the recommendation of an acoustical consultant.

Products Meeting Selection Criteria

BASE TYPE A	No base, isolators attached directly to equipment
BASE TYPE B	Structural Rail Base, Model SBB Integral Structural Beam Base, Model SFB
BASE TYPE C	Concrete Inertia Base Model CIB-L Model CIB-H Model CIB-SS
BASE TYPE D	Roof Curb Rail Model KSR Model KSCR Roof Curb Rail Model ESR

ISOLATOR TYPE 1	Fibreglass Isolation Pad Model KIP Neoprene Isolation Pad Model NP Model NG Model RSP

13	Compressors: The two basic reciprocating compressors are duct structures. (1) singe and double cylinder vertical, horizontal or L-head, which are usually air compressors, and (2) Y, W, and multi head or multi cylinder air and refrigeration compressors. Singe and double cylinder compressors generate high vibratory forces requiring large inertia bases (type C) and are generally not suitable for upper storey locations. If this equipment must be installed in an upper storey location or at grade location near noise sensitive areas, the expected maximum unbalanced force data must be obtained from the equipment manufacturer and a vibration specialist consulted for design of the isolation system.
14	Compressors: When using Y, W and multi head and muti cylinder compressors obtain the magnitude of unbalanced forces from the equipment manufacturer so the need for an inertia base can be evaluated.
15	Compressors: Base mounted compressors through 4KW and horizontal tank type air compressors through 8KW can be installed directly on spring isolators (type 3) with structural bases (type B) if required, and compressors 10 to 75 KW on spring isolators (type 3) with inertia bases (type C) with a mass 1 to 2 times the compressor mass
16	Pumps: Concrete inertia bases (type C) are preferred for all flexible coupled pumps and are desired for most close coupled pumps, through steel bases (type B) can be used. Close coupled pumps should not be installed directly on individual isolators (type A) because the impeller usually overhangs the motor suppler base, causing the rear mounting to be in tension. The primary requirements for type C bases are strength and shape to accommodate base elbow supports. Mass is not usually a factor, except for pumps over 55 KW. where extra mass helps limit excess movement due to starting torque and forces. Concrete bases (type C) should be designed for a thickness of one tenth the longest dimension with minimum thickness as follows: (1) for up to 20 KW, 150mm, (2) for 30 to 55 KW, 200mm, (3) for 75 KW and up 300mm. Pumps over 55 KW and multistage pumps may exhibit excessive motion start up (heaving) supplemental restraining devices can be installed if necessary. Pumps over 90 KW may generate high starting forces, a vibration specialist should be consulted
17	Packaged Rooftop Air Conditioning Equipment: This equipment is usually installed on low mass structures that are susceptible to sound and vibration transmission problems. The noise problems are compounded further by curb mounted equipment which require large roof openings for supply and return air. The table shows type D vibration isolator selections for all spans up to 6 m, but extreme care must be taken for equipment located on spans of over 6m, especially if construction is open web joists or thin, low mass slabs. The recommended procedure is to determine the additional deflection caused by equipment in the roof. If additional roof deflection is 6mm or less, the isolator should be selected for 10 times the additional roof deflection. if additional roof deflection is over 6mm, supplemental roof stiffening should be installed to bring roof deflection down to 6mm, or the unit should be relocated to a stiffer roof position. For mechanical units capable of generating high noise levels, mount the unit on a platform above the roof deck to provide an air gap (buffer zone) and locate the unit away from the associated roof penetration to allow acoustical treatment of ducts before they enter the building. Some rooftop equipment has compressors, fans and other equipment isolated internally. The isolation is not always reliable because of the internal short circuiting. Inadequate static deflection or panel resonance. It is recommended that rooftop equipment over 135kg be isolated externally, as if internal isolation was not used.
18	Cooling Towers: These are normally isolated with restrained spring isolators (type 4) directly under the tower or lower dunnage. High deflection isolators proposed for use directly under the motor-fan assembly must be used with extreme caution to ensure stability and safety under all weather conditions. See Note 5
19	Fans and Air Handling Equipment: Consider the following in selecting isolation systems for fans and air handling equipment. 1. Fans with wheel diameters of 560mm and less and all fans operating at speeds up to 300 rpm do not generate large vibratory forces. For fans operating under 300 rpm, select isolator deflection so the isolator natural frequency is 40% or less than the fan speed. For example, for a fan operating at 275 rpm, x0.4x275=110 rpm. Therefore, an isolator natural frequency of 110 rpm or lower is required. This can be accommodated with a 75mm deflection isolator (type 3). 2. Flexible duct connectors should be installed at the intake and discharge of all fans and air handling equipment to reduce vibration transmission 10. 3. Inertia bases (type C) are recommended for all class 2 and 3 fan and air handling equipment because extra mass allows the use of stiffer springs, which limit heaving movements. 4. Thrust restraints (type 5) that incorporate the same deflection as isolators should be used for all fan heads, all suspended fans, and all base-mounted and suspended air handling equipment operating at 500 Pa or more total static pressure. Restraint movement adjustment must be made under normal operational static pressure.

ISOLATOR TYPE 2	Fibreglass Isolation Mount Model AC Neoprene Isolation Mounts Model RD Model RQ Isolation Hangar Model FH Model RH
ISOLATOR TYPE 3	Free-Standing Steel Spring Model FDS House Spring Isolators Model SL Model SM Isolation Hangar Model SFH Model SRH Model SH
ISOLATOR TYPE 4	Restrained Spring Isolator Model TITAN Model FMS Model FLS Model FLSS Model FHS Model FRS
ISOLATOR TYPE 5	Thrust Restraint Model HSR
ISOLATOR TYPE 6	Air Spring Model KAM Model CAM

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 20 05 49 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Engineering, design, and calculations for seismic restraint
.2 Seismic restraints for equipment, piping, and ductwork
.3 Coordination with Section 20 05 30 Supports and Anchors
.4 Coordination with Section 20 05 48 Vibration Isolation

1.4 REFERENCES

.1 Ontario Building Code
.2 National Building Code
.3 ASHRAE Standard "A Practical Guide to Seismic Restraint",
.4 NFPA 13
.5 SMACNA "HVAC Duct Construction Standards"
.6 Good engineering practice.

1.5 SUBMITTALS

.1 All vibration isolation and seismic restraint systems shall be by one manufacturer. Basis of this design is Vibro-Acoustics.
.2 Submit shop drawings for all devices specified herein and as indicated on the drawings. Submittals shall include dimensions, materials, attachment, and anchorage requirements. Indicate compliance with each specification item herein.
.3 Provide calculations for selection of seismic restraints, certified by a qualified professional engineer licensed in the province where the project is located.
.4 Shop Drawings:
  .1 Provide detailed drawings of all seismic control measures for equipment, duct, and piping.
  .2 Provide separate shop drawings for each isolated system complete with performance and product data, indicating all calculations for loads and deflections.
  .3 Indicate inertia bases and locate vibration isolators, with static and dynamic loads on each.
  .4 Shop drawings shall include engineering calculations for all seismic restraints and attachment. A Professional Engineer registered in the province of the project shall sign, seal and date the calculations.
.5 Product Data: Provide schedule of vibration isolator type with location and load on each.
.6 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
.7 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed design requirements.

1.6 PROJECT RECORD DOCUMENTS

.1 Record actual locations of seismic restraints including attachment points.

1.7 SEISMIC DESIGN CRITERIA

.1 Importance factor for wind load, IW, is 1.0
.2 Importance factor for earthquake loads and effects, IE, is 1.0
.3 Site classification for seismic site response is D
.4 Climatic and Seismic Data from the Ontario Building Code for specific location:

Location	Sa (0.2)	Sa (1.0)	q (1/50)
Brantford	0.19	0.061	0.42

.5 Terms:
- .1 Sa (0.2): Spectral response acceleration for short periods.
- .2 Sa (1.0): Spectral response acceleration for 1-second periods.
- .3 q (1/50): The reference hourly wind velocity pressure in kPa.

1.8 SEISMIC ENGINEER

.1 Professional Engineer holding a Certificate of Authorization in the Province of Ontario with a minimum of 5 years experience in seismic design. Refer to Appendix B of Division 0 for submission requirements.

.2 At the completion of the project, the Seismic Engineer shall review the installations on site, and shall prepare a written report, with a letter signed, sealed, and dated by the Seismic Engineer, certifying that the installations have been completed in accordance with their design and shop drawings.

1.9 SEISMIC CONTROL MEASURES

.1 A single Supplier shall provide seismic design, vibration isolation, and seismic restraint.

.2 Seismic restraints are to be provided for all operational and functional components of building services in accordance with current requirements of the Ontario Building Code.

.3 Cable restraint systems, rod stiffener clamps and seismic isolator capacities shall be verified by an independent test laboratory.

.4 Connection materials shall be selected by and site-specific designs to be prepared by the Seismic Engineer. The Seismic Engineer may select and specify materials and anchors to be provided by the contractor where this is appropriate.

.5 Contractor shall ensure that the Seismic Engineers' requirements and specification are met.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Manufacturer shall be a member of VISCMA.

.2 Acceptable manufacturers.
- .1 Vibro Acoustics
- .2 Kinetic-VIbron
- .3 The VMC Group (Korfond – Masdom)
- .4 Or acceptable equivalent

2.2 GENERAL

.1 All isolation and seismic restraint products supplied by common manufacturer / supplier.

.2 All isolators are to be seismic rated or to be used with a bracing or snubber system.

.3 Colour code springs for load carrying capacity.

.4 Outdoor springs and housings to be corrosion resistant.

.5 Units containing water that can be drained are to use a vertical limiting spring as F-2.

3 EXECUTION

3.1 SEISMIC RESTRAINT

.1 Pipes and Ducts: the following pipe and duct sizes, and larger, must be restrained:
- .1 2.5" (64 mm) diameter pipe in general areas
- .2 1.25" (32 mm) diameter pipe in mechanical rooms
- .3 1" (25 mm) diameter pipe containing hazardous materials and medical piping (i.e., natural gas, oil, medical vacuum, etc.)
- .4 6 square feet face (0.56 square metre) area for duct

.5 any trapeze with a component combined weight that exceeds the above items

.2 Pipes and ducts hung with hanger rods less than 12" (300 mm) in length do not require seismic restraint provided the following conditions are all satisfied:
  .1 All hanger rods in the "run" are attached to the structure with non-moment generating connections; and
  .2 At least 12" (300 mm) clearance on each side of the pipe or duct is provided for the entire "run" so that the pipe or duct can swing freely and shall not contact anything; and
  .3 All hanger rods in a "run" of pipe or duct must be less than 12" (300 mm) in length. If one hanger rod exceeds 12" (300 mm) in a "run", this exception cannot be applied.
  .4 The 12" (300 mm) rule does not apply to suspended equipment.

.3 Base Mounted Equipment: all base mounted equipment requires attachments and seismic restraint as specified by the Seismic Engineer.

.4 Suspended Equipment: all suspended equipment requires seismic restraint.

.5 Roof mounted equipment shall be installed on a structural frame, seismic rated roof curb, or structural curb or frame mechanically connected to the structure. Items shall not be mounted on sleepers or pads that are not mechanically attached to the structure.

.6 Roof mounted piping and ductwork is to be installed on curbs or frames mechanically connected to the building structure. Roof anchors and seismic cables or frames shall be used to resist seismic and wind loading. Wind loading forces shall be determined by the Seismic Engineer.

3.2 INSTALLATION - GENERAL

.1 Install to manufacturer's instructions and adjust mountings to level equipment.

.2 Ensure pipe, duct, and electrical connections to isolated equipment do not reduce system flexibility. Ensure that pipe, conduit, and duct passing through walls and floors do not transmit vibrations.

.3 Install isolation for motor driven equipment.

.4 Bases:
  .1 Set steel bases for 1" (25 mm) clearance between housekeeping pad and base.
  .2 Set concrete inertia bases for 2" (50 mm) clearance between housekeeping pad and base.
  .3 Adjust equipment level.

.5 Install spring hangers without binding.

.6 On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

.7 Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

.8 Provide pairs of horizontal limit springs on fans with more than 1.5 kPa static pressure, and on hanger supported, horizontally mounted axial fans.

.9 Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.06" (1.5 mm) maximum clearance. Provide other snubbers with clearance between 1/8" and 1/4" (4 mm and 7 mm).

.10 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.

.11 Connect wiring to isolated equipment with flexible hanging loop.

3.3 INSTALLATION - EQUIPMENT

.1 Rigid Mounted Equipment:
  .1 Anchor floor and wall mounted equipment to structure as per the seismic shop drawings.
  .2 Suspended equipment shall be restrained using sway bracing, or struts, and hanger rods as per the seismic shop drawings.

.2 Vibration isolated equipment:
  .1 Seismic control measures shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
  .2 Equipment supported by vibration-isolation hangers shall be detailed and installed with isolation hangers tight to the structure and upward limit stops located directly below the

hangers.

3.4 INSTALLATION - PIPING AND DUCT SYSTEMS

.1 Provide seismic control measures with spacing and anchorage engineered for the specific project. Provide rod stiffeners where required.

.2 Maximum Restraint Spacing
- .1 Piping: transverse spacing 40 ft (12 m), longitudinal spacing 80 ft (24 m).
- .2 Duct: transverse spacing 40 ft (12 m), longitudinal spacing 80 ft (24 m).
- .3 Hazardous Material and Medical Piping: transverse spacing 20 ft (6 m), longitudinal spacing 40 ft (12 m).

.3 Support piping connections to isolated equipment resiliently as follows:
- .1 Up to 4" (100 mm) Diameter: First three points of support.
- .2 5" - 8" (125 to 200 mm) Diameter: First four points of support.
- .3 10" (250 mm) Diameter and Over: First six points of support.
- .4 Select three hangers closest to vibration source for minimum 1" (25 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1" (25 mm) static deflection or 1/2 static deflection of isolated equipment.
- .5 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 2" (50 mm).
- .6 Deflection shall be not less than that for the equipment to which the piping is connected.

.4 Seismic systems are to be compatible with requirements for anchoring and guiding of piping systems.

.5 Drilled or power-driven anchors or fasteners not permitted for use with seismic control measures.

.6 Outdoor and roof mounted systems must be mechanically attached to structure. This attachment must account for seismic and wind loading.

.7 Friction due to gravity does not constitute a seismic attachment.

.8 Where equipment is mounted on concrete housekeeping pads the design of reinforcement and anchorage of the pad to the structure shall be performed by the Seismic Engineer. Alternatively, the equipment must be attached through the pad to the base structure, at the Seismic Engineer's discretion.

.9 Do not brace equipment to separate portions of the structure that may act differently in response to an earthquake. For example, do not connect a transverse brace to a wall and a longitudinal brace to a floor or roof at the same brace location.

.10 All duct over 6 square feet (0.56 square metre) are to be hung with a double trapeze at restraint locations, one angle on the top and one angle on the bottom of the duct.

.11 Unless noted otherwise on seismic shop drawings, all duct is to be screwed to the trapeze (top and bottom) with #10 screws at 12" (300 mm) spacing for every trapeze.

.12 All pipes must be attached to trapeze with pipe clamps.

.13 Where pipe or duct size reduces below required dimensions noted in Section 2.3.1, the final restraint shall be installed at the transition location.

.14 Items mounted into T-bar suspended ceiling grids require 4 wires to attach the unit to the structure. The wires and their attachment do not form part of the seismic restraint system. If the ceiling grid is seismically restrained, then the item does not require independent seismic restraint. This design in not in this scope of work, as the ceiling grid is an architectural component.

.15 Sleepers for roof mounted pipes, duct, and equipment require mechanical connection to the building. The forces imposed on this attachment are to be provided by the seismic engineer.

.16 Seismic restraint connections are not to be connected to the bottom chord of steel joists or the bottom flange of steel beams.

.17 Rod stiffeners are required where the hanger rod exceeds the maximum length as shown in the seismic calculation sheets. They are only required at restraint locations.

.18 Standard beam clamps can only be used on seismically restrained components; they cannot be used to connect the seismic restraint to the structure - only for the hanger rods.

.19 Horizontal penetrations through walls should be through a pre-fabricated metal sleeve with a compressible material between the pipe and the sleeve. Vertical penetrations through floors/roofs should use an oversize hole in the structure with compressible material between the hole and the pipe and the pipe should be supported by a clamp resting on two steel load-distributing plates.

.20 Block walls can be used for transverse restraints if the item penetrates the wall at 90 degrees and is a

snug fit. If angles are attached to the item around its perimeter and attached to the wall, then the wall can act as a transverse and longitudinal restraint. Metal stud walls cannot be used for restraint unless specifically designed.

3.5 MANUFACTURER'S FIELD SERVICES

.1 Examine systems to Section 20 01 01 – General Requirements.
.2 Inspect isolated equipment after installation and submit report. Include static deflections.

3.6 PIPE ISOLATION SCHEDULE

Pipe Size (mm)	Isolated Distance from Equipment
25	120 diameters (3.0 m)
50	90 diameters (4.5 m)
80	80 diameters (6.0 m)
100	75 diameters (7.5 m)
150	60 diameters (9.0 m)
200	60 diameters (9.0 m)
250	54 diameters (13.5 m)
300	50 diameters (15.0 m)
400	45 diameters (18.0 m)
600	38 diameters (23.0 m)
Over 600	To be determined by Seismic Engineer

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01

1.2 COMMON WORK RESULTS

.1 Section 20 05 93 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTIONS INCLUDES

.1 Testing, adjustment, and balancing of air systems.
.2 Testing, adjustment, and balancing of piping systems.
.3 Testing, adjustment, and balancing of equipment.
.4 Measurement of final operating condition of HVAC systems.

1.4 REFERENCES

.1 Ontario Building Code.
.2 Ontario Fire Code.
.3 AABC - National Standards for Total System Balance.
.4 ACG - AABC Commissioning Guideline.
.5 ADC - Test Code for Grilles, Registers, and Diffusers.
.6 ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
.7 ASHRAE Guideline 0 The Commissioning Process,
.8 ASHRAE Guideline 1 The HVAC Commissioning Process,
.9 ASHRAE Guideline 1.1 HVAC&R Technical Requirements for the Commissioning Process,
.10 ASHRAE Guideline 5 Commissioning Smoke Management Systems
.11 ASTM E779 Determining Air Leakage Rate by Fan Pressurization.
.12 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
.13 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.
.14 SMACNA HVAC Systems Commissioning Manual.

1.5 SUBMITTALS

.1 Submit name of adjusting and balancing agency complete with all certifications for approval within 30 days after award of Contract.
.2 Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
.3 Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
.4 Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for consultant and for inclusion in operating and maintenance manuals.
.5 Provide reports in PDF format, complete with index page and indexing tabs.
.6 Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
.7 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data based on Project designation IP imperial/SI Metric Units.
.8 All reports shall be prepared in electronic format using MS Word software and all tabulations shall be prepared in electronic format.

1.6 PROJECT RECORD DOCUMENTS

.1 Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.
.2 Record actual locations of flow measuring stations.

1.7 QUALITY ASSURANCE

.1 Perform total system balance to AABC National Standards for Field Measurement and Instrumentation, Total System Balance.
.2 Maintain one copy of each document on site.

1.8 INDEPENDENT AGENCY

.1 All work of Mechanical Testing, Adjusting and Balancing shall be undertaken by a single agency, employed under Mechanical Divisions 20, 21, 22, 23 and 25. Other agencies may be proposed as an Alternate only, in accordance with Section 20 01 01.
.2 The work of the agency consists of the furnishing of all labour, materials, equipment and accessories necessary in the testing, verification and documentation of the operational performance of all equipment and systems installed under the Sections of Mechanical Divisions 20, 21, 22, 23, and 25.

1.9 QUALIFICATIONS

.1 Agency: Company specializing in the testing, adjusting, and balancing of systems under this Section with minimum five years documented experience certified by AABC or prequalified as listed below.
.2 Work shall be performed under the supervision of an AABC certified Test and Balance Engineer, a NEBB Certified Testing, Adjusting and Balancing Supervisor or a registered Professional Engineer experienced in the performance of this work and licensed at the place where the Project is located.

1.10 PRE-BALANCING CONFERENCE

.1 Convene one week prior to commencing work of this Section.

1.11 SEQUENCING

.1 Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
.2 When balancing pressurized spaces, infection control hoarding shall be removed prior to final balancing.

1.12 SCHEDULING

.1 Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

1.13 CO-OPERATION

.1 Co-operate with installing Contractor(s) in advising them of specific scheduling requirements for systems verification.
.2 Provide advice to installing Contractors regarding the location and installation of devices required to permit system balancing and measurements, prior to start of the installation work.
.3 The Contractor shall participate in integrated testing procedures and provide assistance to the Integrated Testing Coordinator, listed under Division 26, for the successful completion of testing mechanical systems under Divisions 21, 22, 23 and 25 with fire protection and life safety functions in accordance with CAN/ULC-S1001 Integrated Systems Testing of Fire Protection and Life Safety Systems.

2 PRODUCTS

2.1 REFERENCE STANDARDS

.1 All equipment required for the verification of equipment and systems shall be furnished by the agency employed to conduct the Mechanical Systems Verification.
.2 Testing and measuring equipment used in the verification of the mechanical systems shall be calibrated to give true readings within the accuracy specifications of the equipment used. A certificate of calibration from an independent testing laboratory may be required by the Consultant if there is any

reason to suspect that the equipment used is giving erroneous readings. In such an event the verification agency shall reconduct its verifications.

.3 All equipment used by the agency in its verification of mechanical systems remains the property/responsibility of the agency and is not included in the supply to the project.

3 EXECUTION

3.1 EXAMINATION

.1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:
- .1 Systems are started and operating in a safe and normal condition.
- .2 Temperature control systems are installed complete and operable.
- .3 Proper thermal overload protection is in place for electrical equipment.
- .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
- .5 Duct systems are clean of debris.
- .6 Fans are rotating correctly.
- .7 Fire and volume dampers are in place and open.
- .8 Air coil fins are cleaned and combed.
- .9 Access doors are closed, and duct end caps are in place.
- .10 Air outlets are installed and connected.
- .11 Duct system leakage is minimized.
- .12 Hydronic systems are flushed, filled, and vented.
- .13 Pumps are rotating correctly.
- .14 Proper strainer baskets are clean and in place.
- .15 Service and balance valves are open.

.2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

.3 Beginning of work represents acceptance of existing conditions in the areas served.

3.2 PREPARATION

.1 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to consultant to facilitate spot checks during testing.

.2 Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

.1 Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

.2 Air Outlets and Inlets: Adjust total to within plus 5 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 5 percent of design.

.3 Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

.1 Ensure recorded data represents actual measured or observed conditions.

.2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

.3 After adjustment, take measurements to verify balance was not disrupted or that such disruption has been rectified.

.4 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

.5 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

.6 Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

.1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
.2 Make air quantity measurements in ducts by Pitot tube traverse of entire cross-sectional area of duct.
.3 Measure air quantities at air inlets and outlets.
.4 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
.5 Use branch volume control dampers and splitters to regulate air quantities. Devices at air outlets may be used only to the extent that adjustments do not create objectionable air motion or sound levels.
.6 Vary total system air quantities by adjustment of fan speeds. Adjust airflow to design quantity. Provide drive changes as required. Make allowances for loading of filters to 100% of manufacturers' recommendations for final pressure at fans with variable speed drives.
.7 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
.8 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan.
.9 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
.10 Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
.11 Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
.12 Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 in.wg. (12.5 Pa) positive static pressure near the building entries.
.13 Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
.14 For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE

.1 Adjust water systems to provide required or design quantities.
.2 Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
.3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
.4 Effect system balance with automatic control valves fully open to heat transfer elements.
.5 Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
.6 Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 SCHEDULES

.1 Equipment requiring testing, adjusting, and balancing:
  .1 Plumbing Pumps
  .2 HVAC Pumps
  .3 Air Coils
  .4 Terminal Heat Transfer Units
  .5 Air Handling Units
  .6 Fans
  .7 Air Filters
  .8 Air Terminal Units

.9 Air Inlets and Outlets

.2 Report Forms

.1 Title Page:

.1 Name of Testing, Adjusting, and Balancing Agency
.2 Address of Testing, Adjusting, and Balancing Agency
.3 Telephone number of Testing, Adjusting, and Balancing Agency
.4 Project name
.5 Project location
.6 Project Architect
.7 Project Engineer
.8 Project Contractor
.9 Project altitude
.10 Report date

.2 Summary Comments:

.1 Design versus final performance
.2 Notable characteristics of system
.3 Description of systems operation sequence
.4 Summary of outdoor and exhaust flows to indicate amount of building pressurization.
.5 Nomenclature used throughout report.
.6 Test conditions

.3 Instrument List:

.1 Instrument
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Range
.6 Calibration date

.4 Electric Motors:

.1 Manufacturer
.2 Model/Frame
.3 HP/BHP
.4 Phase, voltage, amperage; nameplate, actual, no load
.5 RPM
.6 Service factor
.7 Starter size, rating, heater elements
.8 Sheave Make/Size/Bore

.5 V-Belt Drive:

.1 Identification/location
.2 Required driven RPM.
.3 Driven sheave, diameter, and RPM
.4 Belt, size, and quantity
.5 Motor sheave diameter and RPM
.6 Centre to centre distance, maximum, minimum, and actual

.6 Pump Data:

.1 Identification/number
.2 Manufacturer
.3 Size/model
.4 Impeller
.5 Service
.6 Design flow rate, pressure drop, BHP.
.7 Actual flow rate, pressure drop, BHP.
.8 Discharge pressure
.9 Suction pressure
.10 Total operating head pressure
.11 Shut off, discharge and suction pressures.
.12 Shut off, total head pressure.

.7 Air Cooled Condenser:

.1 Identification/number
.2 Location
.3 Manufacturer
.4 Model number
.5 Serial number
.6 Entering DB air temperature, design and actual
.7 Leaving DB air temperature, design and actual
.8 Number of compressors

.8 Cooling Coil Data:
.1 Identification/number
.2 Location
.3 Service
.4 Manufacturer
.5 Air flow, design and actual
.6 Entering air DB temperature, design and actual
.7 Entering air WB temperature, design and actual
.8 Leaving air DB temperature, design and actual
.9 Leaving air WB temperature, design and actual
.10 Water flow, design and actual
.11 Water pressure drop, design and actual.
.12 Entering water temperature, design and actual
.13 Leaving water temperature, design and actual
.14 Saturated suction temperature, design and actual
.15 Air pressure drop, design and actual.

.9 Heating Coil Data:
.1 Identification/number
.2 Location
.3 Service
.4 Manufacturer
.5 Air flow, design and actual
.6 Water flow, design and actual
.7 Water pressure drop, design and actual.
.8 Entering water temperature, design and actual
.9 Leaving water temperature, design and actual
.10 Entering air temperature, design and actual
.11 Leaving air temperature, design and actual
.12 Air pressure drop, design and actual.

.10 Air Moving Equipment
.1 Location
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Arrangement/Class/Discharge
.6 Air flow specified and actual.
.7 Return air flow, specified and actual.
.8 Outside air flow, specified and actual.
.9 Total static pressure (total external), specified and actual
.10 Inlet pressure
.11 Discharge pressure
.12 Sheave Make/Size/Bore
.13 Number of Belts/Make/Size
.14 Fan RPM

.11 Return Air/Outside Air Data:
.1 Identification/location
.2 Design air flow
.3 Actual air flow
.4 Design return air flow

.5 Actual return air flow
.6 Design outside air flow
.7 Actual outside air flow
.8 Return air temperature.
.9 Outside air temperature
.10 Required mixed air temperature.
.11 Actual mixed air temperature
.12 Design outside/return air ratio
.13 Actual outside/return air ratio

.12 Exhaust Fan Data:
.1 Location
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Air flow; specified and actual.
.6 Total static pressure (total external), specified and actual
.7 Inlet pressure
.8 Discharge pressure
.9 Sheave Make/Size/Bore
.10 Number of Belts/Make/Size
.11 Fan RPM

.13 Duct Traverse:
.1 System zone/branch
.2 Duct size
.3 Area
.4 Design velocity
.5 Design air flow
.6 Test velocity
.7 Test air flow
.8 Duct static pressure.
.9 Air temperature
.10 Air correction factor

.14 Duct Leak Test:
.1 Description of ductwork under test
.2 Duct design operating pressure
.3 Duct design test static pressure
.4 Duct capacity, air flow
.5 Maximum allowable leakage duct capacity times leak factor
.6 Test apparatus
.1 Blower
.2 Orifice, tube size
.3 Orifice size
.4 Calibrated
.7 Test static pressure.
.8 Test orifice differential pressure
.9 Leakage

.15 Terminal Unit Data:
.1 Manufacturer
.2 Type, constant, variable, single, dual duct
.3 Identification/number
.4 Location
.5 Model number
.6 Size
.7 Minimum static pressure
.8 Minimum design air flow
.9 Maximum design air flow
.10 Maximum actual air flow

.11 Inlet static pressure

.16 Air Distribution Test Sheet:
- .1 Air terminal number
- .2 Room number/location
- .3 Terminal type
- .4 Terminal size
- .5 Area factor
- .6 Design velocity
- .7 Design air flow
- .8 Test (final) velocity
- .9 Test (final) air flow
- .10 Percent of design air flow

.17 Sound Level Report:
- .1 Location
- .2 Octave bands - equipment off
- .3 Octave bands - equipment on

.18 Vibration Test:
- .1 Location of points:
  - .1 Fan bearing, drive end.
  - .2 Fan bearing, opposite end.
  - .3 Motor bearing, centre (if applicable)
  - .4 Motor bearing, drive end
  - .5 Motor bearing, opposite end
  - .6 Casing (bottom or top)
  - .7 Casing (side)
  - .8 Duct after flexible connection (discharge)
  - .9 Duct after flexible connection (suction)
- .2 Test readings:
  - .1 Horizontal, velocity and displacement
  - .2 Vertical, velocity and displacement
  - .3 Axial, velocity, and displacement
- .3 Normally acceptable readings, velocity, and acceleration
- .4 Unusual conditions at time of test
- .5 Vibration source (if non-complying)

3.8 VERIFICATION CHECKLIST

.1 Prepare a series of checklists to record the verification of each item of equipment and each system. Submit a draft of each checklist to the Consultant and the Owner for review and approval. Discuss comments offered by the Consultant and Owner and include improvements as directed.

.2 Checklists shall include the following as a minimum:
- .1 date(s) of observations and/or tests
- .2 record of the nameplate data for each equipment item and each associated motor,
- .3 list of observations for each equipment item or system with space adjacent to indicate whether the item was satisfactory or unsatisfactory,
- .4 appropriate space for recording comments and/or instructions given during observations.

3.9 EQUIPMENT VERIFICATION

.1 Test the operation of all equipment installed under Mechanical Divisions 20, 21, 22, 23, 25 according to instructions in appropriate articles of this Division. Advice installing contractor of any required adjustments or replacements to ensure that equipment is operating as intended. Retest equipment after adjustment or replacement.

.2 Ensure that the Contractor has given proper advance notification to all persons required to be present during testing.

.3 Instrumentation: verify installation of air filter gauges, pumps, thermometers, thermometer wells, pitot traverse stations, and flow-measuring devices ensuring that:

.1 Location of points for readings is appropriate to measure what it is intended to measure.
.2 The scale range is appropriate to place the normal reading near mid-range of the scale.
.3 Proper positioning of instrumentation to allow reading from a convenient location, and for easy access.

.4 Filters Inspection: visually inspect each filter installation. Verify adjustment of latching devices, installation of end spacers in filter boxes, and proper latching and sealing of access doors. Verify the installation of new (clean) filter media after Contractor's start-up procedures.

.5 Pre-start-up Inspection:
.1 Verify proper equipment mounting and setting.
.2 Verify that control, interlock, and power wiring are complete.
.3 Verify proper alignment of motors and drives.
.4 Verify proper piping connections and accessories.
.5 Verify that lubrication is complete.

.6 First Run Observation:
.1 Verify direction of rotation.
.2 Verify setting of safety controls.
.3 Monitor heat build-up in bearings.
.4 Check motor loads against nameplate ratings.

.7 Equipment Checkout:
.1 Verify the proper overload heater sizes.
.2 Verify function of safety and operating controls.
.3 Verify proper operation of equipment.
.4 Report on inspection, observation, and checkout procedures.

.8 Stuffing Boxes and Packing Glands: verify adjustment of boxes on pump shafts and packing glands on valve stems.

.9 Motor Rotation: Mechanical contractor to visually inspect and verify the direction of motor rotation, even if the electrician verified the motor rotation when power connections were made on temporary electric power, then when final connections were made to the permanent transformer bank, crossed phasing may reverse the rotation of all three-phase motors on the system.

.10 Overload Heaters: verify supply voltage to each equipment. If the applied voltage is different from the motor nameplate, determine whether the applied voltage is within the range allowed under the motor guarantee. If not, take the necessary action to have the Contractor change the motor or the applied voltage. When the voltage is off the nameplate value, but within the allowable range, compute the equivalent amperage at nameplate voltage and compare to the overload heater amperage rating range. Then, consider whether the ambient temperature of the starter is above, below, or the same as the ambient temperature are not the same. Advise the Contractor to use overload heaters of higher range for "hot area" starters or ones of lower range for "cold area" starters to compensate the heater trip point for heat gains or losses with the environment.

.11 Alignment of Drives: verify the alignment of drives, belt and direct coupled, and the adjustment of belt tension.

.12 Control Diagrams and Sequences: provide for coordination with work under the automatic control systems to have the control diagrams and sequences of operation corrected to "as installed", reflecting changes brought about in response to contract modifications and to the more pragmatic changes in diagrams and sequences to make the installed system control the building systems as intended by the designer.

.13 Safety and Operating Control Setpoints: systematically verify the safety and operating controls of equipment, including an operational check of associated control sequences.

.14 Fin Straightening: inspect finned surface heat transfer coils for damages fins and advise Contractor of repairs required.

.15 Verify that manufacturer's start-up procedures were performed, and that equipment is installed in accordance with the manufacturer's written installation recommendations.

.16 Where work is noted to be done in stages a complete air balance and verification report shall be required at the end of each stage.

3.10 PIPING SYSTEMS VERIFICATION

.1 Review the drawings, specifications, and installed work to ensure that systems may be properly

balanced in accordance with drawings. Advise the installing Contractor of any additional requirements for effective balancing.

.2 Complete air balance must have been accomplished before water balance is verified.

.3 Open all valves to full position, including coil stop valves, close bypass valves, and return line balancing cocks.

.4 Verify that all strainers are clean.

.5 Examine water in system to verify it was treated and is clean.

.6 Check pump rotation.

.7 Check diaphragm expansion tanks to ensure that fill pressure is adequate (re. static head of systems plus 5 psig or 12 psig minimum (35 kPa or 83 kPa minimum).

.8 Check open expansion tanks to make sure they are not air bound and that the system is full of water.

.9 Check all air vents at high points of water systems to make sure they are installed properly and are operating freely. Verify that all air is removed from circulating system.

.10 Set all temperature controls so that all coils are calling for full cooling. This should close all automatic bypass valves at coil and chillers. To balance hot water coils, set systems to call for full heating.

.11 Verify operation of automatic bypass valve.

.12 Check and record the following items at each cooling and heating element:

- .1 Inlet water and air temperatures. Note rise or drop in temperature train source.
- .2 Leaving water and air temperatures.
- .3 Pressure drops and flow through each coil.
- .4 Pump operating suction and discharge pressure and final t.d.h. and flow delivered.
- .5 Pressure drops across bypass valve.
- .6 All mechanical specifications of pumps.
- .7 Rated and actual running amperage of pump motor.

.13 Witness all piping tests.

3.11 AIR SYSTEM VERIFICATION

.1 Review drawings, specifications and installed work to ensure that systems may be properly balanced in accordance with drawings. Advise installing Contractor of any additional requirements for effective balancing.

.2 In air handling systems which include supply fans with variable speed drives, airflows shall be verified to design with all filters clean and with all filters loaded to filter manufacturer’s recommended final (change-out) resistance. Motor and drive capacity to accommodate full range of filter loadings shall be verified.

.3 In air handling systems which include supply fans without variable speed drives, air filters shall be verified to design airflows with air filters loaded so that the air pressure drop through each filter is equal to the average of the manufacturers listed initial resistance and recommended final (change-out) resistance.

.4 Test and record blower rpm for each fan and air handling unit.

.5 Test and record motor full load amperes.

.6 Make Pitot tube traverse of main supply and obtain operating air quantities at fans.

.7 Test and record system static pressures, suction, and discharge.

.8 Test and record system operating recirculated air quantities.

.9 Test and record system operating outside air quantities.

.10 Test and record entering dry bulb air temperatures (heating and cooling coils).

.11 Test and record entering wet bulb air temperatures (heating and cooling coils).

.12 Test and record leaving dry bulb air temperatures (heating and cooling coils).

.13 Test and record leaving wet bulb air temperatures (cooling coils only).

.14 Measure airflow in all main and zone branch supply and return air ducts.

.15 Test and record airflow at each diffuser, grille, and register.

.16 Witness and verify results of duct leakage tests conducted under section 23 31 00.

.17 Tabulate and certify test results on suitable forms and submit Consultant for approval and record. Identity each diffuser, grille, and register as to location and area. Identify and list size, type, and manufacturer of diffusers, grilles, registers, and all testing equipment. Use manufacturer's rating on all equipment to make required calculations.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01 – General Requirements

1.2 COMMON WORK RESULTS

.1 Section 20 07 16 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTIONS INCLUDES

.1 Equipment Insulation.
.2 Covering

1.4 REFERENCES

.1 The American Society of Mechanical Engineers
- .1 ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .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 C195 - Mineral Fibre Thermal Insulating Cement.
- .5 ASTM C240 - Testing Cellular Glass Insulation Block.
- .6 ASTM C449/C449M - Mineral Fibre Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .7 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .8 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .9 ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .10 ASTM C552 - Cellular Glass Thermal Insulation.
- .11 ASTM C553 - Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .12 ASTM C592 - Mineral Fibre Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- .13 ASTM C612 - Mineral Fibre Block and Board Thermal Insulation.
- .14 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .15 ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- .16 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .17 ASTM E96 - Water Vapour Transmission of Materials.

.2 North American Insulation Manufacturers Association
- .1 NAIMA National Insulation Standards.

.3 National Fire Protection Association
- .1 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

.4 Underwriters Laboratories
- .1 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

.5 Canadian General Standards Board
- .1 CAN/CG5B-51.11 Mineral Fiber Thermal Insulation Blanket.
- .2 CAN/CG5B-51-GP-52 Ma Vapor Barrier, Jacket & Facing Material for Pipe Duct & Equipment Thermal Insulation.
- .3 CAN/CG5B-51-GP-53 M Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels of Round Ducts.

.6 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

1.5 SUBMITTALS

.1 Refer to Section 20 01 01 – General Requirements
.2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
.3 Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards shall be achieved.
.4 Samples: Submit two samples of any representative size illustrating each insulation type.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
.2 Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.7 REGULATORY REQUIREMENTS

.1 Materials: Flame spread/smoke developed rating of 25/50 to the requirements of the Ontario Building Code.

1.8 DELIVERY, STORAGE, AND PROTECTION

.1 Transport, handle, store, and protect products.
.2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
.3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
.2 Maintain temperature during and after installation for minimum period of 24 hours.

2 PRODUCTS

2.1 GLASS FIBRE, FLEXIBLE

.1 Manufacturers:
  .1 Owens Corning Fiberglas
  .2 Manson
  .3 Knauf Fiber Glass
  .4 Johns Manville
  .5 Or approved alternate
.2 Insulation: ASTM C553; flexible, non-combustible.
  .1 'ksi' Value: ASTM C177 or ASTM C518, 0.035 at 75.2 °F (24 °C).
  .2 Maximum Service Temperature: 250 °F (121 °C).
  .3 Maximum Moisture Absorption: 0.2 percent by volume.
  .4 Density: 2.4 lb/ft3 (38 kg/cu m).
.3 Vapour Barrier Jacket:
  .1 ASTM C921
  .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
  .3 Secure with self-sealing longitudinal laps and butt strips.
  .4 Secure with outward clinch expanding staples and vapour barrier mastic.
.4 Tie Wire: 3/64" (1.22 mm) stainless steel with twisted ends on maximum 12" (300 mm) centres.
.5 Vapour Barrier Lap Adhesive: Compatible with insulation, maximum VOC content of 80 g/L
.6 Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool, maximum VOC content of

80 g/L.

.7 Tape shall be of aluminum, self-adhesive with minimum 2" (50 mm) width.

2.2 GLASS FIBRE, RIGID

.1 Manufacturers:
- .1 Owens Corning Fiberglas AF545
- .2 Manson
- .3 Knauf Fiber Glass
- .4 Johns Manville
- .5 Or approved alternate

.2 Insulation: ASTM C612 or ASTM C592; rigid, non-combustible.
- .1 'ksi' Value: ASTM C177 or ASTM C518,0.035 at 75.2 °F (24 °C).
- .2 Maximum Service Temperature: 450 °F (232 °C).
- .3 Maximum Moisture Absorption: 0.1 percent by volume.
- .4 Density: 16 kg/cu m.

.3 Vapour Barrier Jacket:
- .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
- .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
- .3 Secure with self-sealing longitudinal laps and butt strips.
- .4 Secure with outward clinch expanding staples and vapour barrier mastic.

.4 Facing: 1" (25 mm) galvanized steel hexagonal wire mesh stitched on one face of insulation.

.5 Vapour Barrier Lap Adhesive: Compatible with insulation, maximum VOC content of 80 g/L.

.6 Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool, maximum VOC content of 80 g/L.

2.3 PHENOLIC INSULATION

.1 Manufacturers:
- .1 Manufacturer: Resolco Inc. Insulphen Phenolic Insulation
- .2 Or approved alternate

.2 Insulation: ASTM C-1126 Phenolic Foam Thermal Insulation, CFC and HCFC free, rigid moulded, non-combustible insulation fabricated in required shapes by Resolco International approved fabricators or approved alternate to ASTM C-450 and C-585.
- .1 Density: 40-kg/m3 [2.5-lb/ft3]
- .2 Temperature range: -290°F to +250°F (-129°C to +107°C)
- .3 Closed cell content: 92%
- .4 Compressive strength: 2 bars [29 psi]
- .5 Thermal conductivity: 0.18 BTU-in/hr-ft2-°F (18.72 W-mm/m2-°C)
- .6 Fire resistance rating: flame spread less than 25 and smoke developed less than 50 to ULC S102 and ASTM E84 on plain and faced product up to 3" (75 mm) thick

.3 Joint Sealer:
- .1 Vapour barrier type, moisture and water resistant, 97% solids by weight, non-hardening, flexible in temperature range from -5°F to +200°F (-20.5°C to +93.3°C), Daxcel 161D, Fosters 30-45, Childers CP-76.

.4 Vapour Barrier Mastic / Reinforcing:
- .1 Vimasco Vapor-Block, Fosters 30-80, #749 or Childers' Chil-Perm #CP-35, or approved equal with the following minimum requirements:
  - .1 Wet Flammability: No flash to boiling.
  - .2 Water Vapor Permeance: Maximum 0.08 US perms
  - .3 Average Non-Volatile: 58% by volume
  - .4 Service Temperature Range: -20°F to +190°F (-29°C to 88°C)
  - .5 Application: Two Coats
- .2 The membrane for reinforcement of vapor retardant mastic shall be 6 X 6 or 10 X 10 glass fiber reinforcing mesh, Chil Glas #5 made by Childers or PC-79 Fabric, 5 X 6 mesh, by Pittsburgh Corning, or approved equal.

.5 Vapour Barrier (Indoor Service)

.1 Vapor barrier for indoor service shall be ASJ All Service Jacket as manufactured by Compac Corp or Lamtec Corp or approved alternate as per the Resolco UL E84 test reports, constructed from 0.00035 inch thick aluminum foil laminated to 30lb. Kraft paper by flame retardant adhesive. The complete laminated product shall be reinforced with tri directional fiberglass yarn with yarn spacing of 5 per inch.

.2 Venture 1555U factory applied zero perm jacket system shall be used in areas of high humidity or where there is a risk of mould/mildew growth.

.3 In areas of heavy mechanical abuse or high pressure wash down areas use product for Outdoor Service.

.6 Vapour Barrier (Outdoor Service)

.1 The vapor barrier used to seal any plain pipe insulation for outdoor service prior to application of cladding shall be Polyguard Insulrap 30 (or approved alternate) rubberized bitumen adhesive laminated to a 4 mil polyethylene film. Total thickness shall be 30 mils (0.76mm), permeance; 0.015 max, or approved equal.

.2 Polyguard 650 LT Liquid Adhesive or approved alternate is required at application temperatures below 50°F (10°C) or with dusty insulation surfaces. As an alternative to the use of Liquid Adhesive, a light pass may be made with a heat gun over the face of the adhesive mass, just prior to application.

.3 Insulrap 30 is an acceptable alternative for equipment/vessels from tangent to tangent to reinforced vapor barrier mastic stated in paragraphs 5.3.3.1 and 5.3.6.1 above. Heads must be sealed with the mastic and fabric. VentureClad 1577CW self-adhesive zero perm vapor barrier / weatherproof jacket may also be used.

.4 Peel & Seal, self-stick, aluminum embossed finish; by Polyguard Products may be considered as an alternative, outdoors. It eliminates the need for metal cladding; however, it is recommended for installation above +60°F (15.5°C) and in no case, below +40°F (4.4°C).

.5 All outdoor jacket systems shall be banded using 1/2" (15 mm) .020 aluminum banding with wing seals at 12" (300 mm) centers.

.7 Fabrication Adhesive

.1 Fabrication adhesive for Insul-Phen shall be H.B. Fuller's SC-1454, a contact adhesive or H.B. Fuller's HL-2278, hot melt adhesive, or approved equal.

.8 Pipe and Hanger Supports

.1 Pipe support load bearing insulation shall be fabricated by a manufacturer approved fabricator from Resolco (or approved alternate) CFC & HCFC free heavy density Insul-Phen in 3.75lb/ft3 density in accordance with the table in attachment 1. The upper 1870° section of the support can be fabricated from standard 2.5lb./ft3 density Insul-Phen and 2.5lb./ft3 can be used at the support point up to a certain pipe diameters (contact local manufacturer approved fabricator or technical rep) with a 12" (300 mm) long saddle.

.2 The pipe support insulation shall be supported by a saddle. Stainless steel saddles shall be used where edible food or open product is exposed. For all other applications it is acceptable to use painted, galvanized or carbon steel.

.9 PVC Cladding (Indoor Use only)

.1 The jacketing to provide protection to insulation and vapor barrier shall be 0.030 inch thick Ceel-Co 300 Series UVR PVC Jacketing or Proto LoSmoke 25/50 UVR PVC or approved equivalent. Jacketing shall be tough all purpose, UV resistant capable of enduring frequent washing with hot water or other cleaning agents. All joints of PVC jacket shall be solvent welded with Ceeltite or Proto PVC Adhesive. As an alternative a high density (3.75lb) phenolic along with 0.020 PVC jacket can be used.

.2 Ceel-Co 300 Series or Proto LoSmoke UVR PVC Jacket, or approved equivalent .040 inch, or a double wrap of .030 inch thick shall be used where protection from mechanical abuse or high-pressure washing is required.

.3 A stainless steel diamond-mesh expanded metal lath cage shall be installed with spacers a minimum of 1" (25 mm) away from and over top of the pipe and insulation sealed with PVC Jacket in areas where it is possible for knives, etc. to damage jacket system.

.4 In food preparation/hygenic areas cladding must withstand scalding water washdowns; wherever a higher temperature material is required: Proto EXOD (R), a CPVC material, light grey and is rated to +225°F (107.2°C). EXOD (R) shall be ordered "cut and precurled" for pipe insulation jacket.

.10 Aluminum Cladding (Outdoor Use only)
- .1 The metal cladding weather barrier to provide protection from weather, mechanical wear or other damage shall be aluminum alloys 3003, 1100 or 3105 meeting ASTM B209 with H-14 temper, 0.016 inch thick with Polysurlyn moisture barrier on the back side. The metal jacketing shall be RPR Incul-mate, Childers Products or approved equal.
- .2 .016 inch thick aluminum is acceptable for all piping except where excessive abuse is anticipated; .024 inch thick shall be used on all equipment as minimum; however, .032 inch thick is preferred.
- .3 The metal cladding where frequent washing is anticipated, shall be smooth for all piping and horizontal equipment and 1-1/4" (30 mm) corrugated for all vertical equipment above 30" (750 mm) insulation OD. Stucco embossed finish may be used for other areas.
- .4 Where foot traffic is likely and increased strength of jacket is necessary use rolls of pipe jacketing; Childers Corrolon or RPR Rib-Cor, 3/16 inch corrugated in the circumferential direction

.11 Fastening Accessories
- .1 Tape for fastening plain pipe covering insulation shall be 3/4 inch Fiberglass reinforced strapping tape made by National Tape Co. or approved equal.
- .2 Stainless steel type T304/T316 or .020 aluminum strapping for fastening aluminum jacketing outdoors and outer layer of vessel and/or large diameter (above 16 inches O.D.) pipe insulation shall be 1/2 inch X .020 inch thick with stainless steel or aluminum wing seals made by RPR Products, Childers Products or approved equal. RPR no. 7 or breather spring 4 inches long made from stainless steel type T305 shall be used for securing large diameter vessels metal jacketing.
- .3 Polypropylene 1/2" (15 mm) wide, 1/2" (15 mm) thick banding and clips, Q-Band/Q-Clip made by Band-It Inc. shall be used for securing PVC jacketing indoors. The banding shall not be used in food processing areas where bacterial growth is anticipated. Banding may be used for temporary securement until PVC joint adhesive cures. The PVC Jacketing must be complete sealed at all joints to prevent entry of water or moisture. In non-food processing areas PVC jacketing should be glued using manufacturers adhesive.

.12 Inspection Plugs
- .1 NDT Inspection plugs made from EPDM and aluminum metal cap as manufactured by Parker Special Products shall be installed on pipe and equipment requiring frequent inspections. Use 1-1/2" (40 mm) NDT plug for pipe and equipment insulation jacket OD of less than 9" (225 mm). Use 2-1/2" (65 mm) and 3" (75 mm) NDT plug for pipe and equipment between 9" (225 mm) and 24" (600 mm) insulation jacket OD. Use 5" (125 mm) NDT plug for pipe and equipment insulation jacket OD above 24" (600 mm).

.13 Expansion/Contraction Joint Insulation
- .1 Expansion/contraction joint material shall be 1lb/ft3 density fiberglass blanket.

2.4 ELASTOMERIC INSULATION

.1 Manufacturers:
- .1 Armacell APArmaflex
- .2 APArmaflex W
- .3 APArmaflex SS
- .4 APArmaflex SA.
- .5 Or approved alternate

.2 Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular or sheet form to ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."

.3 Insulation materials shall have a closed-cell structure to prevent moisture from wicking.

.4 Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's, formaldehyde free, low VOC's, fiber free, dust free and shall resist mold and mildew.

.5 Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ULC S102, ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.

.6 Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
.7 Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
.8 The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and water vapor transmission.
.9 Adhesives and finishes shall be as recommended by the insulation manufacturer and shall comply with Section 20 05 00 Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.

2.5 CELLULAR GLASS

.1 Manufacturers:
  .1 Pittsburgh Corning FOAMGLAS.
  .2 Or approved alternate
.2 Insulation: ASTM C552 "Standard Specification for Cellular Glass Thermal Insulation",
  .1 'k' Value: 0.039 at 75°F (24°C).
  .2 Maximum Service Temperature: 900°F (482° C).
  .3 Maximum Water Vapour Transmission: 0.1 perm.
  .4 Maximum Moisture Absorption: ASTM C240, 0.2% by volume.
  .5 Density: 128 kg/cu m.
.3 FOAMGLAS® pipe insulation shall be fabricated according to the requirements of ASTM C1639 "Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation".

2.6 HYDROUS CALCIUM SILICATE

.1 Manufacturers:
  .1 Industrial Insulation Group Model Thermo-12
  .2 Or approved alternate
.2 Insulation: ASTM C533, Type 1; rigid, moulded, white, asbestos free, corrosion inhibiting.
  .1 Thermal conductivity (k) value: ASTM C177, C335 and C518.

Mean Temperature ˚F	200	300	400	500	600	700
BTU-in/ (Hr-Ft^2-F^o	0.41	0.45	0.5	0.55	0.6	0.65
Mean Temperature ˚C	93	149	204	260	316	371
W/(m-C^o)	0.059	0.065	0.072	0.079	0.086	0.094

  .2 Maximum Service Temperature: 1200°F (649°C).
  .3 Density: 14.5 lb/ft3 (232 kg/m3) to ASTM C302
  .4 Flexural strength: 65 psi (448 kPa)
  .5 Compressive strength: >100 psi (690 kPa), 5% compression, to ASTM C165
  .6 Mould Growth: Does not support (ASTM C1338)
  .7 Surface burning characteristics: Flame spread0, Smoke developed: 0. (ULC
.3 Tie Wire: stainless steel with twisted ends on 12" (300mm) centres maximum.
.4 Insulating Cement: to ASTM C449 and Section 20 05 00insu.

2.7 JACKETS

.1 Canvas Jacket: UL listed.
  .1 Fabric: ASTM C921, 220 g/sq m, plain weave cotton treated with dilute fire-retardant lagging adhesive.
  .2 Lagging Adhesive:
    .1 Compatible with insulation.
.2 PVC Jacket (Indoor):
  .1 Jacket: ASTM C921, One piece sheet material.

.1 Minimum Service Temperature: -31 °F (-35 °C).
.2 Maximum Service Temperature: 150 °F (66 °C).
.3 Moisture Vapour Transmission: ASTM E96; 0.03 perm inches.
.4 Maximum Flame Spread: ASTM E84; 25 or less.
.5 Maximum Smoke Developed: ASTM E84; 50 or less.
.6 Thickness: 20 mil (0.4 mm) minimum.

.2 Colour: standard off-white

.3 Covering Adhesive Mastic
.1 Compatible with insulation, low VOC.

.4 Manufacturer:
.1 Ceel-Co 300 series
.2 Speedline Smoke Safe
.3 Or approved alternate

2.8 REMOVABLE / REUSABLE INSULATION COVERS

.1	Material:	Teflon coated, woven fibreglass fabric
.2	Weight:	16.5 oz/sq. yd. (± 10%)
.3	Thickness:	0.015" (± 10%)
.4	Colour:	Gray
.5	Tensile Strength:	400 x 330 lb. (W x F)
.6	Tarp Tear strength:	60 x 40 lb. (W x F)
.7	Mullen Burst Pressure:	650 psi.
.8	Insulation thickness:	Match connecting piping.
.9	Temperature Range:	-67°F to 500°F
.10	Lacing Hooks:	Stainless Steel
.11	Tie Wire:	16-ga stainless steel

2.9 ACCESSORIES

.1 Adhesives and finishes shall be as recommended by the insulation manufacturer and shall comply with Section 20 05 00. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.
.2 Vapor retarder lap adhesive shall be water based, fire retardant.
.3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50 mm) width.
.4 Tie wire shall be of 1/16" (1.5 mm) ø stainless steel.
.5 Fasteners shall be of 1/8" (4 mm) Ø pins, with 35 mm square clips. Clip length to suit insulation thickness.
.6 Bands shall be 1/2" (12 mm) wide 1/4" (6mm) thick galvanized steel.
.7 Facing shall be of 1" (25 mm) galvanized steel hexagonal wire mesh attached on both faces of insulation.

3 EXECUTION

3.1 EXAMINATION

.1 Verify that equipment has been tested before applying insulation materials.
.2 Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

.1 Install equipment insulations to TIAC National Installation Standards.
.2 Apply insulation materials, accessories, jackets and finishes in accordance with manufacturer' written instructions and as specified.
.3 Do not insulate factory insulated equipment.
.4 Exposed Equipment: Locate insulation and cover seams in least visible locations.
.5 Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

.6 Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapour barrier cement.
.7 Insulated equipment containing fluids below ambient temperature: Insulate entire system.
.8 Fibreglass insulated equipment containing fluids below ambient temperature: Provide vapour barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapour barrier adhesive.
.9 For hot equipment containing fluids 140°F (60°C) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
.10 For hot equipment containing fluids over 140°F (60°C), insulate flanges and unions with removable sections and jackets.
.11 Fibreglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapour barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
.12 Inserts and Shields:
  .1 Application: Equipment 1-1/2 " (40 mm) diameter or larger.
  .2 Shields: Galvanized steel between hangers and inserts.
  .3 Insert location: Between support shield and equipment and under the finish jacket.
  .4 Insert configuration: Minimum 6" (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  .5 Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
.13 Finish insulation at supports, protrusions, and interruptions.
.14 Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket.
.15 Exterior Applications: Provide vapour barrier jacket or finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
.16 Cover glass fibre insulation with metal mesh and finish with heavy coat of insulating cement.
.17 Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
.18 Provide removable / reusable insulation covers for equipment, devices and fittings requiring access for maintenance, repair, or cleaning.

3.3 EQUIPMENT INSULATION

.1 Insulate new or altered equipment and re-insulate existing equipment where insulation has been removed or damaged as follows:

Mineral Fiber Blanket - Hot Surfaces 68ºF - 750°F (20°C - 400°C)		
Item	**Thickness (Inches)**	**Thickness (mm)**
Heating Pumps including Fittings & Accessories	2"	50 mm
Expansion Tanks, Air Separators	2"	50 mm
Any Other Equipment Operating at High Temp.	2"	50 mm

Flexible Elastomeric Unicellular Sheet - Cold Surfaces		
Item	**Thickness (Inches)**	**Thickness (mm)**
Expansion Tanks and Air Separators	1-1/2"	38 mm
Roof Drain Sumps	1-1/2"	38 mm
Water Meter	1"	25 mm
Strainer Heads in Cold Piping	2"	50 mm
Any Other Equipment Operating at Low Temp	1-1/2"	38 mm

.2 Phenolic insulation may be used in place of rigid fibreglass equipment insulation, thickness to provide equivalent thermal resistance.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.1 COMMON WORK RESULTS

.1 Section 20 07 19 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.2 SECTIONS INCLUDES

.1 Piping insulation.
.2 Jackets and accessories.

1.3 REFERENCES

.1 The American Society of Mechanical Engineers
- .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .3 ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .4 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- .5 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.
- .6 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .7 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .8 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .9 ASTM C547 - Mineral Fibre Pipe Insulation.
- .10 ASTM C552 - Cellular Glass Thermal Insulation.
- .11 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .12 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- .13 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.
- .14 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.
- .15 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .16 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- .17 ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
- .18 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
- .19 ASTM E84 - Surface Burning Characteristics of Building Materials.
- .20 ASTM E96 - Water Vapour Transmission of Materials.

.2 National Fire Protection Association
- .1 NFPA 255 - Surface Burning Characteristics of Building Materials.

.3 Underwriters Laboratories
- .1 UL 723 - Surface Burning Characteristics of Building Materials.

.4 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

.5 North American Insulation Manufacturers Association
- .1 NAIMA National Insulation Standards.

1.4 SUBMITTALS

.1 Product Data: Provide product description, list of materials and thickness for each service, and locations.
.2 Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship

and installation standards shall be achieved.

1.5 QUALITY ASSURANCE

.1 Materials: Flame spread/smoke developed rating of 25/50 or less to ULC S102 and ASTM E84.

1.6 QUALIFICATIONS

.1 Applicator: Company specializing in performing the work of this section with minimum three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Transport, handle, store, and protect products.
.2 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
.3 Store insulation in original wrapping and protect from weather and construction traffic.
.4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
.2 Maintain temperature during and after installation for minimum period of 24 hours.

2 PRODUCTS

2.1 GLASS FIBRE

.1 Manufacturers:
  .1 Owens Corning Fiberglas
  .2 Manson
  .3 Knauf Fiber Glass
  .4 Johns Manville
  .5 Or approved alternate
.2 Insulation: ASTM C547; rigid moulded, non-combustible.
  .1 'ksi' value: ASTM C335, 0.035 at 75°F (24°C).
  .2 Minimum Service Temperature: -20°F (-28.9°C).
  .3 Maximum Service Temperature: 302°F (150°C).
  .4 Maximum Moisture Absorption: 0.2 percent by volume.
.3 Vapour Barrier Jacket
  .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
  .2 Moisture Vapour Transmission: ASTM E96; 0.02 perm.
  .3 Secure with self-sealing longitudinal laps and butt strips.
  .4 Secure with outward clinch expanding staples and vapour barrier mastic.
.4 Tie Wire: 1.3 mm stainless steel with twisted ends on maximum 12" (300 mm) centres.
.5 Vapour Barrier Lap Adhesive
  .1 Compatible with insulation.
.6 Insulating Cement/Mastic
  .1 ASTM C195; hydraulic setting on mineral wool, VOC content not to exceed 80 g/L.
.7 Fibrous Glass Fabric
  .1 Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
  .2 Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
.8 Indoor Vapour Barrier Finish
  .1 Vinyl emulsion type acrylic, compatible with insulation, white colour, VOC content not to exceed 250 g/L.
.9 Outdoor Vapour Barrier Mastic

.1 Vinyl emulsion type acrylic, compatible with insulation, white colour.

.10 Insulating Cement

.1 ASTM C449, VOC content not to exceed 80 g/L.

2.2 PHENOLIC INSULATION

.1 Manufacturers:

.1 Resolco International by "Insul-Phen"

.2 Teqtix

.3 Or approved alternate

.2 Insulation: ASTM C-1126 Phenolic Foam Thermal Insulation, CFC and HCFC free, rigid moulded, noncombustible insulation fabricated in required shapes by Resolco International approved fabricators to ASTM C-450 and C-585.

.1 Density: 2.5-lb/ft^3 (40-kg/m^3)

.2 Temperature range: -290°F to +250°F (-129°C to +107°C)

.3 Closed cell content: 92%

.4 Compressive strength: 29 psi (2 bar)

.5 Thermal conductivity: 0.13 BTU-in/hr-ft^2-°F (18.72 W-mm/m^2-°C)

.6 Fire resistance rating: 25/50 to ASTM E84 on plain and faced product up to 3" (75mm) thick.

.3 Joint Sealer:

.1 Vapour barrier type, moisture, and water resistant, 97% solids by weight, non-hardening, flexible in temperature range from -5°F to +200°F (-20.5°C to +93.3°C), Daxcel 161D, Fosters 30-45, Childers CP-76.

2.3 ELASTOMERIC INSULATION

.1 Manufacturers:

.1 Armacell APArmaflex

.2 APArmaflex W

.3 APArmaflex SS

.4 APArmaflex SA.

.5 Or approved alternate

.2 Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular or sheet form to ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."

.3 Insulation materials shall have a closed-cell structure to prevent moisture from wicking.

.4 Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's, formaldehyde free, low VOC's, fiber free, dust free and shall resist mold and mildew.

.5 Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ULC S102, ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive, and all materials shall pass simulated end-use fire tests.

.6 Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft^2- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

.7 Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.

.8 The material shall be manufactured under an independent third-party supervision testing program covering the properties of fire performance, thermal conductivity, and water vapor transmission.

.9 Adhesives and finishes shall be as recommended by the insulation manufacturer and shall comply with Section 20 05 00. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.

2.4 HYDROUS CALCIUM SILICATE

.1 Manufacturers:

.1 Industrial Insulation Group Model Thermo-12

.2 Insulation: ASTM C533, Type 1; rigid, moulded, white, asbestos free, corrosion inhibiting.

.1 Thermal conductivity (k) value: ASTM C177, C335 and C518.

Mean Temperature	**°F**	**200**	**300**	**400**	**500**	**600**	**700**
BTU-in/(Hr-Ft2-F°)		**0.41**	**0.45**	**0.5**	**0.55**	**0.6**	**0.65**
Mean Temperature	**°C**	**93**	**149**	**204**	**260**	**316**	**371**
W/(m-C°)		**0.059**	**0.065**	**0.072**	**0.079**	**0.086**	**0.094**

.2 Maximum Service Temperature: 1200°F (649°C).
.3 Density: 14.5 lb/ft3 (232 kg/m3) to ASTM C302
.4 Flexural strength: 65 psi (448 kPa)
.5 Compressive strength: >100 psi (690 kPa), 5% compression, to ASTM C165
.6 Mould Growth: Does not support (ASTM C1338)
.7 Surface burning characteristics: Flame spread: 0, Smoke developed: 0. (ULC S102)

.3 Tie Wire: stainless steel with twisted ends on 12" (300mm) centres maximum.
.4 Insulating Cement: to ASTM C449.

2.5 JACKETS

.1 PVC Plastic
  .1 Jacket: ASTM C921, one-piece moulded type fitting covers and sheet material.
    .1 Minimum Service Temperature: -31°F (-35°C).
    .2 Maximum Service Temperature: 151°F (66°C).
    .3 Moisture Vapour Transmission: ASTM E96; 0.03 perm inches.
    .4 Maximum Flame Spread: ASTM E84; 25 or less.
    .5 Maximum Smoke Developed: ASTM E84; 50 or less.
    .6 Thickness: 20 mil (0.4 mm) minimum.
  .2 Colour: standard off-white OR coloured to suit pipe identification.
  .3 Covering Adhesive Mastic
    .1 Compatible with insulation, maximum VOC content of 50 g/L.
  .4 Manufacturer:
    .1 Ceel-Co 300 series
    .2 Speedline Smoke Safe
    .3 Or approved alternate

.2 Aluminum Jacket: ASTM B209.
  .1 Thickness: 0.02" (0.40 mm) sheet.
  .2 Finish: Smooth.
  .3 Joining: Longitudinal slip joints and 2" (50 mm) laps.
  .4 Fittings: 0.02" (0.40 mm) thick die shaped fitting covers with factory attached protective liner.
  .5 Metal Jacket Bands: 3/8" (10 mm) wide; 0.01" (0.38 mm) thick aluminum.

2.6 REMOVABLE / REUSABLE INSULATION COVERS

.1 Material: Teflon coated, woven fibreglass fabric
.2 Weight: 16.5 oz/sq. yd. (± 10%)
.3 Thickness: 0.015" (± 10%)
.4 Colour: Gray
.5 Tensile Strength: 400 x 330 lb. (W x F)
.6 Tarp Tear strength: 60 x 40 lb. (W x F)
.7 Mullen Burst Pressure: 650 psi.
.8 Insulation thickness: Match connecting piping.
.9 Temperature Range: -67°F to 500°F
.10 Lacing Hooks: Stainless Steel
.11 Tie Wire: 16-ga stainless steel

2.7 ACCESSORIES

.1 Adhesives and finishes shall be as recommended by the insulation manufacturer and shall comply with Section 20 05 00 Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.
.2 Vapor retarder lap adhesive shall be water based, fire retardant.
.3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50 mm) width.
.4 Tie wire shall be of 1/16" (1.5 mm) ø stainless steel.
.5 Fasteners shall be of 1/8" (4 mm) Ø pins, with 35 mm square clips. Clip length to suit insulation thickness.
.6 Bands shall be 1/2" (12 mm) wide 1/4" (6mm) thick galvanized steel.
.7 Facing shall be of 1" (25 mm) hexagonal wire mesh made from galvanized steel and attached on both faces of insulation.

3 EXECUTION

3.1 EXAMINATION

.1 Verify that piping has been tested before applying insulation materials.
.2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

.1 Install piping insulations to TIAC National Installation Standards.
.2 Apply insulation materials, accessories, jackets and finishes in accordance with manufacturer' written instructions and as specified.
.3 On exposed piping locate insulation and cover seams in least visible locations.
.4 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
    .1 Provide vapour barrier jackets, factory-applied or field applied.
    .2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.
    .3 Finish with glass cloth and vapour barrier adhesive.
    .4 PVC fitting covers may be used.
    .5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
    .6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
.5 For insulated pipes conveying fluids above ambient temperature:
    .1 Provide standard jackets, with or without vapour barrier, factory-applied or field applied.
    .2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
    .3 Finish with glass cloth and adhesive.
    .4 PVC fitting covers may be used.
    .5 For hot piping conveying fluids 140°F (60°C) or less, do not insulate flanges and unions at equipment, but bevel and seal end of insulation.
    .6 For hot piping conveying fluids over 140°F (60°C), insulate flanges and unions at equipment.
.6 Inserts and Shields:
    .1 Application: Piping 1-1/2" (40 mm) diameter or larger.
    .2 Shields: Galvanized steel between pipe hangers or pipe rolls and inserts.
    .3 Insert Location: Between support shield and piping and under the finish jacket.
    .4 Insert Configuration: Minimum 6" (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
    .5 Insert Material: hydrous calcium silicate insulation.
.7 Finish insulation at supports, protrusions, and interruptions.
.8 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement.
.9 Provide integral vapour barrier jacket on insulation on pipe and fittings for exterior applications.
.10 Provide PVC jacket and fitting covers for pipe in mechanical equipment rooms and where exposed in finished spaces, except steam and condensate which is required to have aluminum jackets and fitting covers.

.11 Provide aluminum jacket and fitting covers with seams located on bottom side of horizontal piping for the following:
.1 When installed in exterior/outdoor applications, or
.2 When installed in mechanical room, where working fluid temperature is > 200°F (93°C).
.3 All steam and condensate are required to have aluminum jackets and fitting covers.

.12 For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

.13 For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 PIPE INSULATION

.1 Insulate new or altered piping with rigid pipe insulation as follows:

RIGID PIPE INSULATION (I-P)			
Service	**Operating Temperature Range °F**	**Pipe Diameter in.**	**Insulation Thickness in.**
Cold water make-up (Outside building)	0 to 50	All sizes	2
Condensate (cold)	0 to 50	All sizes	1/2
Domestic cold water	0 to 50	All sizes	1
Sanitary drainage (horizontal)	40 to 55	All sizes	1
Domestic hot water & Hot water recirculation	106 and higher	2 and smaller	1
		2-1/2 and larger	1-1/2
Storm drainage (horizontal)	40 to 55	All sizes	1
Hydronic heating (hot water)	>350	Smaller than 1	4-1/2
		1 and larger	5
	251 to 350	Smaller than 1	3
		1 to smaller than 1-1/2	4
		1-1/2” and larger	4-1/2
	201 to 250	Smaller than 4	2-1/2
		4 and larger	3
	141 to 200	Smaller than 1 up to smaller than 1-1/2	1-1/2
		1-1/2 and larger	2
	105 to 140	Smaller than 1 up to smaller than 1-1/2	1
		1-1/2” and larger	1-1/2
FLEXIBLE INSULATION			
Service			**Insulation Thickness**

Horizontal storm and sanitary drainage	1"

RIGID PIPE INSULATION (SI)			
Service	**Operating Temperature Range °C**	**Pipe Diameter (mm)**	**Insulation Thickness (mm)**
Cold water make-up (Outside building)	-18 to 10	All sizes	50
Condensate (cold)	-18 to 10	All sizes	13
Domestic cold water	-18 to 10	All sizes	25
Domestic hot water & Hot water recirculation	41 and higher	50 and smaller	25
		65 and larger	40
Sanitary drainage (horizontal)	4 to 13	All sizes	25
Storm drainage (horizontal)	4 to 13	All sizes	25
Hydronic heating (hot water)	>177	Smaller than 25	112
		25 and larger	125
	122 to 177	Smaller than 25	75
		25 to smaller than 40	100
		40 and larger	112
	94 to 121	Smaller than 100	65
		100 and larger	75
	61 to 93	Smaller than 25 up to smaller than 40	40
		40 and larger	50
	41 to 60	Smaller than 25 up to smaller than 40	25
		40 and larger	40

FLEXIBLE INSULATION	
Service	**Insulation Thickness**
Horizontal storm and sanitary drainage	25mm

.2 Phenolic insulation may be used in place of rigid fibreglass pipe insulation, thickness to provide equivalent thermal resistance.

.3 Insulate valves, flanges and pipe connections with removable / reusable insulation covers.

.4 Wrap butt joints with a 4" (100 mm) strip of fire-resistant vapour barrier jacket cemented with lagging adhesive.

.5 Where the pipe hanger is around the insulation, provide an insulation protection shield within the pipe saddle. Coordinate with installation of hangers.

.6 Insulate all fittings, flanges, and valves on pipes to provide equivalent insulation to that on adjoining pipe.

.7 Continue insulation through sleeves including specified finish.

.8 Cut back covering on strainers and finish off to expose removable head insulation.

.9 Cover expansion joints first with 24 gauge (0.7 mm) galvanized metal sleeve and then insulate to

provide equivalent thickness to that on adjoining pipe.

.10 Protect insulation with protection saddles where insulated pipe is supported by rollers.

.11 Insulate pipe hangers supporting new piping carrying water at 70°F (21°C) or less to prevent condensation. Extend insulating material along hanger rod to height 4 times thickness of insulation. Seal insulation with vapour proof sealant.

.12 Extend pipe insulation and covering through walls, floors, ceilings, and concrete beams, unless indicated otherwise on drawings. Protect exposed insulation extending through floors with 4" (100 mm) wide strip of 18 gauge (1.3 mm) galvanized iron.

.13 Pack annular space between pipe sleeves and piping or pipe covering with glass fibre insulation or rockwool insulation. In fire rated assemblies use Dow Silicon RTV or other ULC listed materials. Seal exposed insulation with mastic.

.14 Recover exposed surfaces of insulated piping installed in exposed areas, mechanical rooms, and equipment rooms with PVC jacketing and PVC fitting covers installed in accordance with manufacturer's instructions.

.15 Insulate and cover exposed surfaces of waste connections, traps, hot and cold supply risers and valves at each lavatory and sink designated for "handicapped" or "barrier free" use with: PVC insulated fitting covers specifically designed for this application. Vinyl material is not to exceed flame spread rating of 150, and if intended to be used in high buildings, its smoke developed classification does not exceed 300. Zeston or other equivalent material. or foamed plastic type insulation finished with two coats of Armstrong Armflex or other equivalent material.

.16 Provide aluminum metal cladding over the insulation on the following services:

.1 All exposed piping located outdoors.

.2 All steam and condensate piping.

.17 Insulate sprinkler and standpipe main from take-off from domestic water to a point approximately 6 feet (1800 mm) after electrically supervised valve.

.18 Oversize insulation of Domestic hot water piping complete with heating cable for pipe sizes 1-1/4" (35 mm) dia. and smaller by 1/4" (6 mm) in inside diameter to allow for installation over heating cable.

3.4 REFRIGERATION PIPE INSULATION

.1 Insulate all refrigerant suction and hot gas piping and fittings with flexible foamed plastic pipe insulation. Insulation shall fit pipe. Thickness shall be minimum 1" thick for refrigerant lines running at the exterior for the building. Interior refrigerant piping shall be insulated end to end with ½" closed cell pipe insulation for piping up to 1" in diameter or ¾" for 1-1/8" and larger.

.2 Slip insulation on to tubing before tubing sections and fittings are assembled. Keep slitting of insulation to a very minimum. Seal all joints in the insulation with Armaflex 520 BLV. Insulate flexible pipe connectors.

.3 On insulation exposed outside the building, place "slit" joint seams on bottom of pipe and cover with UV-resistant PVC jacket. Extend insulation through pipe support clamps. Provide a 6" (150 mm) long, 20 gauge (1.1 mm) galvanized steel sleeve around pipe insulation at each support.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 20 90 50 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 MECHANICAL-ELECTRICAL EQUIPMENT SCHEDULE

.1 The following Mechanical-Electrical Equipment Schedule is provided to assist the Contractor in coordinating the efforts of sub-trades. The assignment of work among subcontractors is the Contractor's responsibility and the Contractor is free to amend the schedule as he sees fit.

.2 The Mechanical-Electrical Equipment Schedule also describes work that is required and may or may not be described elsewhere. All work indicated in the Mechanical-Electrical Equipment Schedule shall be included in the Bid Price.

.3 The Mechanical-Electrical Equipment Schedule shall not limit the extent of the Contract in any way. Work indicated elsewhere or otherwise needed for a complete and functioning installation shall be provided whether or not shown in the Mechanical-Electrical Equipment Schedule.

1.4 RESPONSIBILITY CODES

.1 Responsibility Codes in the Mechanical Equipment Schedule shall be interpreted as follows:

.1 "Supplied by Div." means that the equipment is to be supplied to the site under the division described by number.

.2 “Installed by Div.” means that the equipment is to be received from the supplier, handled, set in place and installed at the site under the Division described by number.

.3 “Wired and connected by Div.” means that the equipment and its associated devices are to be wired and connected to the various electrical systems in accordance with the equipment manufacturer’s installation instructions and wiring diagrams under the Division described by number.

END OF SECTION

Mechanical / Electrical Schedule

No.	Equipment				Controls			Responsibility		
	Item	Characteristics		Service / Location	Type	Location	Manufacturer's Reference	Supplied by Div.	Installed By Div.	Wired & Connected by Div.
1	Rooftop Unit RTU-1 (Admin Area)	FLA	25	High Roof	Disconnect	Integral to VFD	See Mech Spec	23	23	26
		MCA	31		VFD	At RTU	See Mech Spec	23	23	26
		MOCP	35		BAS	TBD on Site	See Spec	25	25	25
		Supply HP	1 x 2HP		Other Controls	See Drawings	See Mech Spec	23	23	23
		Exhaust HP	1 x 1HP		Fire Alarm Relay	at VFD	See Spec	26	26	26
		Voltage	575							
		Phase	3							
		Freq.	60							
	Rooftop Unit Receptacle	Amps	20	Refer to Electrical Drawings	Receptacle	At RTU	Weatherproof cove	26	26	26
		Voltage	120							
		Phase	1							
		Freq.	60							
	Single point of electrical connection. Co-ordinate fire alarm relay between M&E sub-Contractors and CAN/ULC S524.									
2	Rooftop Unit RTU-2 (Cats Intake Area)	FLA	45	Low Roof	Disconnect	Integral to VFD	See Mech Spec	23	23	26
		MCA	56		VFD	At RTU	See Mech Spec	23	23	26
		MOCP	60		BAS	TBD on Site	See Spec	25	25	25
		Supply HP	1 x 2HP		Other Controls	See Drawings	See Mech Spec	23	23	23
		Exhaust HP	1 x 1HP		Fire Alarm Relay	at VFD	See Spec	26	26	26
		Voltage	575							
		Phase	3							
		Freq.	60							
	Rooftop Unit Receptacle	Amps	20	Refer to Electrical Drawings	Receptacle	At RTU	Weatherproof cove	26	26	26
		Voltage	120							
		Phase	1							
		Freq.	60							
	Single point of electrical connection. Co-ordinate fire alarm relay between M&E sub-Contractors and CAN/ULC S524.									
3	Rooftop Unit RTU-3 (Adoption Area)	FLA	69	Low Roof	Disconnect	Integral to VFD	See Mech Spec	23	23	26
		MCA	72		VFD	At RTU	See Mech Spec	23	23	26
		MOCP	80		BAS	TBD on Site	See Spec	25	25	25
		Supply HP	1 x 5HP		Other Controls	See Drawings	See Mech Spec	23	23	23
		Exhaust HP	1 x 2HP		Fire Alarm Relay	at VFD	See Spec	26	26	26
		Voltage	575							
		Phase	3							
		Freq.	60							
	Rooftop Unit Receptacle	Amps	20	Refer to Electrical Drawings	Receptacle	At RTU	Weatherproof cove	26	26	26
		Voltage	120							
		Phase	1							
		Freq.	60							
	Single point of electrical connection. Co-ordinate fire alarm relay between M&E sub-Contractors and CAN/ULC S524.									
4	Rooftop Unit RTU-4 (Dogs Intake Area)	FLA	59	Low Roof	Disconnect	Integral to VFD	See Mech Spec	23	23	26
		MCA	62		VFD	At RTU	See Mech Spec	23	23	26
		MOCP	70		BAS	TBD on Site	See Spec	25	25	25
		Supply HP	1 x 5HP		Other Controls	See Drawings	See Mech Spec	23	23	23
		Exhaust HP	1 x 2HP		Fire Alarm Relay	at VFD	See Spec	26	26	26
		Voltage	575							
		Phase	3							
		Freq.	60							
	Rooftop Unit Receptacle	Amps	20	Refer to Electrical Drawings	Receptacle	At RTU	Weatherproof cove	26	26	26
		Voltage	120							
		Phase	1							
		Freq.	60							
	Single point of electrical connection. Co-ordinate fire alarm relay between M&E sub-Contractors and CAN/ULC S524.									
5	Heating Heat Pump HP-1	MCA	70	High Roof	Disconnect	At Unit	See elec spec	26	26	26
		MOCP	90		Other Controls	See Dwgs.	See spec	23	23	23
		Voltage	575		BAS	TBD on Site	See spec	25	25	25
		Phases	3							
		Freq.	60							
		kW	31.8							

6	Primary Heat Pump Circulator P-4	HP	1	Mechanical / Electrical Room	Disconnect	In VFD	See mech spec	23	23	26
		Voltage	208		VFD	At Unit	See mech spec	23	23	26
		Phase	1		Other Controls	See Dwgs.	See spec	23	23	25
		Freq.	60		Alarms	See spec	See spec	25	25	25
					BAS	TBD on Site	See spec	25	25	25
					VFD complete with HOA and red pilot light in cover			23	23	26
7	Primary Boiler Pump P-3	HP	1/6	Mechanical / Electrical Room	Disconnect	In VFD	See mech spec	23	23	26
		Voltage	115		VFD	At Unit	See mech spec	23	23	26
		Phase	1		Other Controls	See Dwgs.	See spec	23	23	25
		Freq.	60		Alarms	See spec	See spec	25	25	25
					BAS	TBD on Site	See spec	25	25	25
					VFD complete with HOA and red pilot light in cover			23	23	26
8	Main Circulation Pump P-2A & P-2B	HP	1	Mechanical / Electrical Room	Disconnect	In VFD	See mech spec	23	23	26
		Voltage	208		VFD	At Unit	See mech spec	23	23	26
		Phase	1		Other Controls	See Dwgs.	See spec	23	23	25
		Freq.	60		Alarms	See spec	See spec	25	25	25
					BAS	TBD on Site	See spec	25	25	25
					VFD complete with HOA and red pilot light in cover			23	23	26
9	Electric Boiler B-1	Voltage	600	Mechanical / Electrical Room	Disconnect (WP)	Integral to Unit	See Mech Spec	23	23	26
		Phases	3		Other Controls	See Mech Dwgs	See Mech Spec	23	23	23
		Freq.	60		BAS	TBD on Site	See Spec	25	25	25
		kW	70							
10	Exhaust Fan EF-1 (Dog Isolation)	HP	1 x 1/8HP	Low Roof	Disconnect (WP)	Integral to VFD	See Mech Spec	23	23	26
		Voltage	115		VFD	See Mech Dwgs	See Mech Spec	23	23	26
		Phases	1		Motorized Damper	At Roof	See Spec	23	23	25
		Freq.	60		RPM	See Mech Dwgs	See Spec	25	25	25
					Other Controls	See Mech Dwgs	See Mech Spec	23	23	23
					BAS	TBD on Site	See Spec	25	25	25
12	Exhaust Fan EF-2 (Cat Isolation)	HP	1 x 1/8HP	Low Roof	Disconnect (WP)	Integral to VFD	See Mech Spec	23	23	26
		Voltage	115		VFD	See Mech Dwgs	See Mech Spec	23	23	26
		Phases	1		Motorized Damper	At Roof	See Spec	23	23	25
		Freq.	60		RPM	See Mech Dwgs	See Spec	25	25	25
					Other Controls	See Mech Dwgs	See Mech Spec	23	23	23
					BAS	TBD on Site	See Spec	25	25	25
13	Exhaust Fan EF-3 Mechanical / Electrical Room Exhaust	HP	1 x 1/8HP	Mechanical / Electrical Room	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Phases	1		Other Controls	See Dwgs.	See spec	23	23	23
		Freq.	60		Motorized Damper	In Duct	See spec	23	23	25
					BAS	TBD on Site	See spec	25	25	25
					Starter complete with HOA and red pilot light in cover					
14	Exhaust Fan EF-4 Receiving Bay Safety Exhaust	HP	1 x 1/8HP	Receiving Bay	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Phases	1		Other Controls	See Dwgs.	See spec	23	23	23
		Freq.	60		Motorized Damper	In Duct	See spec	23	23	25
					BAS	TBD on Site	See spec	25	25	25
					Starter complete with HOA and red pilot light in cover					
15	Exhaust Fan EF-5 Wild Life Room	Watts	11.1W	Wild Life Room	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Amps	0.26 A		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Other Controls	See Dwgs.	See spec	23	23	23
		Phases	1		Motorized Damper	In Duct	See spec	23	23	25
		Freq.	60		BAS	TBD on Site	See spec	25	25	25
					Starter complete with HOA and red pilot light in cover					
16	Exhaust Fan EF-6 Washroom	Watts	23.3W	Staff Washroom	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Amps	0.3 A		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Other Controls	See Dwgs.	See spec	23	23	23
		Phases	1							
		Freq.	60							
17	Exhaust Fan EF-7 Washroom	Watts	23.3W	Universal Washroom	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Amps	0.3 A		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Other Controls	See Dwgs.	See spec	23	23	23
		Phases	1							
		Freq.	60							
18	Cabinet Unit Heater CUH-1, 2, 3, 4, 5, 6	Fans	1/10HP	See Drawings for Number and Locations	Disconnect	At Unit	See Elec Spec	26	26	26
		Amps	1.7A		Controller	At Unit	See Mech Spec	23	23	26
		Voltage	120		Thermostat	See Drawings	See Mech Spec	25	25	25
		Phases	1		Other Controls	See Drawings	See Spec	23	23	23
		Freq.	60							
19	Unit Heaters UH-1, 2, 3, 4	HP	1 x 1/8HP	See Drawings	Starter	See Dwgs.	See Mech Spec	26	26	26
		Amps	1.35A		Thermostat	See Dwgs.	See Mech Spec	25	25	25
		Voltage	120		Disconnect	At unit	See Elec Spec	26	26	26
		Phases	1		Other Controls	See Dwgs.	See Spec	23/25	23/25	23/25
		Freq.	60							
20	Electronic Trap Seal Primer Manifold and Mini	Amp	15	See Drawings	24 VAC Direct Connection	At unit	See elec spec	22	22	26
		Voltage	120							
		Phase	1							
		Freq.	60							
21	Domestic Hot Water Heater - Hybrid Heat Pump/Electric DHWH-1 & 2	Amp	30A	See Drawings	Direct Connection	See elec dwgs	See elec spec	26	26	26
		Voltage	208		Disconnect	At unit	See mech spec	22	22	26
		Phases	1		BAS	TBD on Site	See spec	25	25	25
		Freq.	60							
22	Domestic Hot Water Recirc Pump P-1	HP	1/6	Mechanical / Electrical Room	Disconnect	See starter	See Starter	26	26	26
		Voltage	120		Starter	At unit	AB#512 series	26	26	26
		Phases	1		Other Controls	By unit	See mech spec	22	22	22
		Freq.	60							

23	Motorized Damper	Voltage	120	See Dwgs	Damper	See Dwgs.	See Mech Spec	25	23	25
		Phases	1		Actuator	See Dwgs.		25	25	25
		Freq.	60		Contols/BAS			25	25	25
24	Glycol Fill Station	Watts	50	Mechanical / Electrical Room	Plug in	At unit	See spec	23	26	26
		Voltage	120		Other Controls	See Dwgs.	See spec	23	23	23
		Phase	1							
		Freq.	60							

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 20 05 00 specifies items common to all Sections of Divisions 21, 22, 23, 25 and applies to and governs all work of Divisions 21, 22, 23, 25.

1.3 SECTION INCLUDES

.1 Portable Fire Extinguishers
.2 Fire Extinguisher Brackets

1.4 REFERENCES

.1 FM - Factory Mutual System - Approval Guide.
.2 NFPA 10 - Portable Fire Extinguishers.
.3 ULC - Fire Protection Equipment Directory.

1.5 SUBMITTALS FOR REVIEW

.1 Section 20 01 01
.2 Product Data: Provide manufacturers literature including general assembly, type and rating of extinguishant.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

.1 Refer to section 20 01 01
.2 Project Record Documents: Record actual locations of components and accessories.
.3 Maintenance Data: Include manufacturers literature, cleaning procedures, replacement parts lists, and repair data for pumps, drivers and controllers.

1.7 QUALITY ASSURANCE

.1 Perform Work to NFPA 10
.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

.1 ULC listed and labelled
.2 Rated and identified in conformance with CAN/ULC S508, "Rating and Fire Testing of Fire Extinguishers".

2 PRODUCTS

2.1 GENERAL

.1 Manufacturers
  .1 National Fire Equipment
  .2 Flag
  .3 Kent
  .4 Pyrene Canada

.5 CFH
.6 Safety Supply Chubb
.7 Or approved alternate

2.2 MULTI-PUPURPOSE DRY CHEMICAL

.1 Type: multi-purpose (ABC) type, dry chemical
.2 Size: 5 lb. (2.27 kg)
.3 Rating: minimum 3A:10Bc.

OR

.4 Type: multi-purpose (ABC) type, dry chemical
.5 Size: 10 lb. (4.54 kg)
.6 Rating: minimum 4A:60Bc

2.3 CARBON DIOXIDE

.1 Type: carbon dioxide type
.2 Size: 10 lb. (4.54 kg)
.3 Rating: minimum 5BC.

2.4 BRACKETS

.1 Wall Mounting Brackets
  .1 Manufactured of steel with a primed and powder coated finish, to meet the latest ULC salt spray requirement) ASTM B117.
  .2 Provided by the fire extinguishers manufacturer.

3 EXECUTION

3.1 INSTALLATION

.1 Install to manufacturer's instructions.
.2 Conform to NFPA 10.
.3 Locate and secure cabinets plumb and level. Establish top of cabinet (inside horizontal surface) 65" (1675 mm) above finished floor.
.4 Locate fire extinguisher in cabinet as indicated.
.5 Install with wall mounting bracket where not installed in cabinets.

3.2 APPLICATIONS

.1 Provide fire extinguishers where indicated and in conformance with the Ontario Fire Code and NFPA 10.
.2 Provide 10 lb. (4.54 kg) multi-purpose extinguishers in mechanical rooms.
.3 Provide 10 lb. (4.54 kg) carbon dioxide extinguishers in electrical rooms, communications rooms and Data centres
.4 Provide 5 lb. (2.27 kg) multi-purpose extinguishers in each fire hose cabinet and in each kitchen/kitchenette.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 SECTION INCLUDES

.1 Roof Drains
.2 Floor Drains
.3 Trench Drains
.4 Hair/Sediment Interceptor
.5 Trap Seal Primers
.6 Cleanouts
.7 Hose bibbs and Hydrants.
.8 Backflow Prevention.
.9 Water Hammer Arrestors.
.10 Thermostatic Mixing Valves.
.11 Domestic Hot Water Expansion Tank

1.3 REFERENCES

.1 ASME A112.21.1 - Floor Drains.
.2 ASME A112.21.2 - Roof Drains.
.3 ASME A112.26.1 - Water Hammer Arrestors.
.4 ASSE 1011 - Hose Connection Vacuum Breakers.
.5 ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
.6 ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.
.7 ASSE 1003-23/CSA S356:23 for Water Pressure Reducing Valves for Potable Water Distribution Systems
.8 AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
.9 PDI WH-201 - Water Hammer Arrestors.
.10 CAN/CSA B64.10 – Selection and Installation of Backflow Preventers / Maintenance and Field Testing of Backflow Preventers (current version)
.11 NSF/ANSI 61 – Drinking Water System Components – Health Effects
.12 NSF/ANSI 372 – Drinking Water System Components – Lead Content

1.4 SUBMITTALS FOR REVIEW

.1 Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
.2 Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

1.5 SUBMITTALS FOR INFORMATION

.1 Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

.1 Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.
.2 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND PROTECTION

.1 Accept specialties on site in original factory packaging. Inspect for damage.

2 PRODUCTS

2.1 GENERAL

.1 Manufacturer: Watts Drainage model indicated or equivalent by:
- .1 Zurn
- .2 Jay R. Smith
- .3 Mifab
- .4 Precision Plumbing Products.
- .5 Or approved alternate

.2 Wall Hydrants
- .1 Manufacturer: Jay R. Smith Drainage model indicated or equivalent by:
  - .1 Watts
  - .2 Zurn
  - .3 Or approved alternate

.3 Trench Drain
- .1 Manufacturer: ACO Drainage model indicated or equivalent by:
  - .1 Polydrain
  - .2 MEA
  - .3 Or approved alternate

.4 Hair/sediment interceptor
- .1 Manufacturer: Watts model indicated or equivalent by:
  - .1 Zurn
  - .2 MIFAB
  - .3 J.R. Smith
  - .4 Or approved alternate

.5 Backflow Preventer
- .1 Manufacturer: Watts drainage model indicated or equivalent by:
  - .1 ITT
  - .2 Zurn/Wilkins
  - .3 Conbraco
  - .4 Or approved alternate

.6 Expansion Tank:
- .1 Manufacturer: Amtrol model indicated or equivalent by:
  - .1 Watts
  - .2 Myers
  - .3 Taco
  - .4 Or approved alternate

2.2 ROOF DRAINS

.1 Standard roof with insulation thicker than 1-1/2" (38 mm): lacquered cast iron deep sump body, flashing clamp ring with integral gravel stop, press to lock linear polyethylene plastic dome strainer, extension and bearing pan, underdeck clamp and water-proofing flange.
- .1 Watts RD-100-BED-W-1

.2 Inverted roof: lacquered cast iron deep sump body, underdeck clamp, flashing clamp ring with integral gravel stop, press lock linear polyethylene plastic dome strainer, and adjustable extension with auxiliary drainage slots and secondary clamp.
- .1 Watts RD-100-CH-D

2.3 FLOOR DRAINS

.1 Floor Drain (FD):
- .1 Watts Drainage model FD-1100-C-5

.2 ANSI A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable round stainless steel strainer with removable perforated sediment bucket.

.2 Funnel Floor Drain (FFD):
- .1 Watts Drainage Model FD-100-C-EG
- .2 ANSI A112.21.1; epoxy coated cast iron floor drain with anchor flange, reversible membrane clamp with primary and secondary weepholes, 5 in. (127mm) diameter 1/4 in. (6mm) thick adjustable nickel bronze strainer, 4 in. (102mm) x9 in. (229mm) oval cast iron funnel, full open throat strainer opening and no hub outlet.

.3 Shower Drains (SD):
- .1 Watts Drainage Model WSD-THD
- .2 lacquered cast iron two piece body with adjustable stainless steel strainer.

2.4 TRENCH DRAIN

.1 Trench ACO KS100 Kassikdrain, Grate: 451D

.2 Trench drain system consists of 39" (1000 mm) long, 6" (150 mm) wide, 4" (100 mm) radiused bottom with 0.6% built-in slope suitable for internal and external applications, with an integral cast-in stainless steel rail edge, with preformed drill outs for outlet connections, full length anchoring ribs, grate locking slots interlocking ends.

.3 Grate: Perforated 16-gauge stainless steel 304, ADA iron, Class A. complete with boltless grate locking system.

2.5 SEDIMENT/HAIR INTERCEPTOR (SI-1)

.1 Watts SI-800-HDC-SS

.2 All stainless steel sediment interceptor

.3 Flow rating of 75 USGPM.

.4 Includes one-piece removable bucket, code approved deep seal trap, cover securing bolts, recessed non-skid removable rectangular cover.

.5 Rated for installation in concrete slab, cover flush with top of slab.

2.6 TRAP SEAL PRIMERS

.1 Individual Traps – Continuous Flow:
- .1 Watts Drainage model MS-810
  Automatic cast brass body, renewable disc and seat rings, vacuum breaker and removable cover.
- .2 Mifab model MI-TSP-1 brass trap seal primer with removable poppet, integral vacuum breaker, gasketed access cover, 1/2" (13) N.P.T. inlet and outlet connections, complete with 1/2" (13) sweat connection adaptors and 1/2" (13) drip line connection.

.2 Groups of Traps – 3 PSI Pressure Drop Activated:
- .1 MIFAB model MR-500 pressure drop activated brass trap seal primer, with inlet opening of 1/2" (13) male N.P.T. and outlet opening of female 1/2" (13) N.P.T. Complete with four view holes and removable filter screen. Serves up to 6 floor drain traps and requires no adjustments and no air pre-charge.
- .2 MIFAB model M1-500 pressure drop activated brass trap seal primer, with inlet opening of 1/2" (13) male N.P.T. and outlet opening of female 1/2" (13) N.P.T. Complete with four view holes and removable filter screen. Serves up to 10 floor drain traps and requires no adjustments and no air pre-charge.
- .3 MIFAB model M2-500 pressure drop activated brass trap seal primer, with inlet opening of 1/2" (13) male N.P.T. and outlet opening of female 1/2" (13) N.P.T. Complete with four view holes and removable filter screen. Serves up to 3 floor drain traps and requires no adjustments and no air pre-charge.

.3 Distribution Manifold
- .1 MIFAB model MI-DU trap seal primer distribution unit with four 3/8" (10) F.P.T. brass nipple outlet connections to serve either 2, 3, or 4 floor drain traps and a 1/2" (13) M.P.T. inlet connection. Unit complete with four 1/4" (6) diameter vent holes in the lid and three 1/8" (3)

diameter Phillips Head screws to secure the lid to the body.

.4 Electronic Trap Priming Manifold

.1 Enclosed Electronic Trap Seal Primer System

MIFAB® Series MI-100* (*specify 5 to 35 outlet ports) enclosed electronic trap seal primer system with timer, ½" F.I.P. plastic ball valve, lead free bronze vacuum breaker, 1/2" stainless steel solenoid valve and plastic manifold with distribution ports. (specify -500 for 1/2" or -625 for 5/8" port connections when ordering). Electrical components to include single point power connection at 120VAC or 24VDC, manual override switch, minimum 5 amp breaker, 24 hour timer with relay and adjustable delay. All components to be factory assembled and installed into a 16-gauge satin coated steel box for recessed (standard) or surface mounted (specify suffix -SM) installation. The entire assembly is tested and certified to the ASSE 1044 Standard. 100 p.s.i. operating pressure.

2.7 CLEANOUTS

.1 Exterior Surfaced Areas:
- .1 Watts Drainage model CO-1200-R
- .2 Round stainless-steel access frame and non-skid cover.

.2 Interior Finished Floor Areas:
- .1 Watts Drainage model CO-1200-R, CO-200-U
- .2 Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored stainless steel cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

.3 Interior Finished Wall Areas:
- .1 Watts Drainage model WUCO
- .2 Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless-steel access cover secured with machine screw.

.4 Interior Unfinished Accessible Areas: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

.5 Line Cleanouts: lacquered cast iron Malcom type with cleanout ferrule, 1/2" (13mm) thick epoxy coated gasketted cover.

.6 Caulking for cleanouts: VOC content not to exceed 250g/L.

2.8 HOSE BIBBS AND HYDRANTS

.1 Exterior Wall Hydrant, (NFWH):
- .1 Jay R. Smith 5515 or approved alternate
- .2 ANSI/ASSE 1019B; non-freeze, self-draining type with stainless steel box and cover for recessed mounting, all bronze head, seat casting and internal working parts, 3/4" (20 mm) hose thread spout, quarter turn operated, integral vacuum breaker, integral check valve and integral stops, drop down locking hinged cover.

.2 Interior Wall Hose Bibb, (HB-1):
- .1 Jay R. Smith 5670-H or approved alternate
- .2 Wall mounted, bent nose sill cock faucet with hose vacuum breaker, bronze body construction with polished chrome plated finish, handwheel handle, tamper proof, back siphonage protection.

.3 Receiving Bay Wall Hose Bibb, (HB-2):
- .1 Jay R. Smith 5560QT or approved alternate
- .2 Wall mounted, bronze quarter turn non-freeze hydrant with hose connection for hot and cold water, vacuum breakers, T handle key and bronze box with chrome plated face.

2.9 BACKFLOW PREVENTION

.1 Double Check Valve Assembly Backflow Preventer 1/2" to 2" (15 - 50mm)

Shall be installed at each noted location. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves; four top

mounted, resilient seated test cocks. Provide bronze strainer. Temperature Range 1/2" to 2": 33°F - 180°F (0.5°C - 82°C). Lead Free.
Temperature Range 2-1/2" to 3": 33°F - 110°F (0.5°C - 43°C) continuous, 140°F (60°C) intermittent.
Watts Series LF007

.2 Double Check Valve Assembly Backflow Preventer 2-1/2" to 10" (65 - 250mm)
The Double Check Valve Assembly shall consist of two independent tri-link check modules within a single housing, sleeve access port, four test cocks and two drip tight shut-off valves. Tri-link checks shall be removable and serviceable, without the use of special tools. The housing shall be constructed of 304 Schedule 40 stainless steel pipe with groove end connections. Tri-link checks shall have reversible elastomer discs and in operation shall produce drip tight closure against reverse flow caused by backpressure or back siphonage. Temperature Range: 33°F - 140°F (0.5°C - 60°C) Maximum Working Pressure: 175psi (12.1 bar). Provide strainer ahead of the backflow preventer to prevent the fouling of the check assembly and resulting spillage from the valve during re-pressurization. Lead Free.
Watts Series 757, 757N
When installing a drain line on Series 957 backflow preventers use 957AG air gaps.

.3 Reduced Pressure Backflow Preventers 3/4" to 2" (20 to 50 mm):
A Reduced Pressure Zone Assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves. Back siphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel, or directly into the supply pipe via a separate vent. The assembly shall include two tightly closing shutoff valves before and after the assembly, test cocks and a protective strainer upstream of the No. 1 shutoff valve. Temperature Range: 33°F - 140°F (0.5°C - 60°C) continuous, 180°F (82°C) intermittent
Watts Series 909QTS
For installation in Domestic Hot Water supply lines provide model Watts 909QTSHW with stainless steel check modules and stainless-steel strainer. Temperature Range: 33°F - 210°F (0.5°C - 99°C)
When installing a drain line use 909AG series Air Gaps on Series 909 backflow preventers.

.4 Reduced Pressure Backflow Preventers 1/4" to 1/2" (8 to 15 mm):
A Reduced Pressure Zone Assembly shall be installed at each potential health hazard location to prevent backflow due to back-siphonage and/or backpressure. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting. Pressure/Temperature: Suitable for supply pressure up to 175psi (12 bar). Water temperature: 33°F - 180°F (0.5°C - 75°C).
Watts Series 009QTS
When installing a drain line use 909AG series Air Gaps on Series 909 backflow preventers.

2.10 WATER HAMMER ARRESTORS

.1 Watts Drainage Series 05 or approved alternate

.2 ANSI A112.26.1; copper construction, piston type sized to PDI WH-201, precharged suitable for operation in temperature range 33°F to 100°F (0.5°C to 82°C) and maximum 150 psi (1000 kPa) working pressure.

2.11 THERMOSTATIC MIXING VALVE

.1 Bradley HL45 – S59-3045 or approved alternate

.2 Thermostatic water mixing valve, Factory pre-assembled and tested, rough bronze finish, integral check stops on inlets, adjustable set point withing temperature range, positive shut-off of flow in the event of cold water supply line failure or thermostat failure, dial thermometer, 125 psi max working pressure, 200°F max temperature. 0.5 gpm minimum flow with hot water recirculation. Piped according to manufacturer’s requirements with hot water recirculation.

.3 Provide line size solenoid valves and shock absorber.

.4 Capacity 19 usgpm @ 10 psig pressure differential.

2.12 DOMESTIC HOT WATER EXPANSION TANK

.1 Amtrol ST-30VC-DD or approved alternate
150 PSI maximum working pressure, carbon steel shell, stainless steel connections, ASME deep diaphragm, stainless steel connection, maximum operating temperature 200F, Factory pre-charge: 55 psig, prime painted exterior, constructed to ASME section VIII.

3 EXECUTION

3.1 GENERAL

.1 Install all products in accordance with the plumbing code and with manufacturer's instructions.

3.2 ROOF DRAINS

.1 Locate roof drains where indicated on roofing plans.
.2 Inspect locations where roof drains are shown to determine that roof is sloped appropriately. Report concerns to Consultant prior to installation of drains.
.3 Coordinate installation with roofing trade.

3.3 FLOOR DRAINS AND TRENCH DRAINS

.1 Provide floor and trench drains where indicated on architectural and plumbing floor plans.
.2 Inspect locations where floor drains are shown to determine that floor is sloped appropriately. Report concerns to Consultant prior to installation of drains.
.3 Coordinate installation with general trades.
.4 Trap and vent all floor drains in accordance with Plumbing Code.
.5 Provide trap seal priming for each floor drain trap.
.6 Floor drains in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.
.7 Floor drains, traps and drain pipes installed in slabs on grade shall be embedded in concrete and made water-tight to prevent water seepage.

3.4 TRAP SEAL PRIMERS

.1 Traps may be primed from the flush tube of a flush valve or from the waste of a drinking fountain.
.2 No more than three (3) traps may be primed from one flush valve or one drinking fountain.
.3 Condensate drains from cooling units may not be used to prime traps.
.4 Trap seal primers shall be provided where flush valves and/or drinking fountains are not available.
.5 Group trap primers shall be provided where specifically shown and where agreed with the Consultant.

3.5 CLEANOUTS

.1 Cleanouts shall be the same size as the pipe up to 4" (100mm) and not less than 4" (100mm) for larger pipes.
.2 Provide cleanouts at the end of mains and branches, at changes in direction, in long straight runs and at the base of all soil stacks and rainwater leaders and where required by code.
.3 Extend cleanouts to finished floor or wall surface.
.4 Encase exterior cleanouts in concrete flush with grade.
.5 Install floor cleanouts at elevation to accommodate finished floor.
.6 Cleanouts in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.
.7 Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.
.8 Ensure clearance at cleanout for rodding of drainage system.

3.6 HOSE BIBBS AND WALL HYDRANTS

.1 Locate wall hydrants where indicated.
.2 Coordinate installation with general trades.

3.7 BACKFLOW PREVENTION

.1 Backflow prevention includes backflow preventers, anti-siphon devices and vacuum breakers.
.2 Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur:
  .1 On boiler feed water lines,
  .2 Housekeeping faucets,
  .3 Premise isolation,
  .4 Irrigation systems,
  .5 Flush valves,
  .6 Interior and exterior wall hydrants (hose bibbs).
  .7 Where required by codes, regulations and/or standards.
.3 Pipe relief or drain from backflow prevention device to nearest drain.
.4 Install a strainer upstream of each backflow preventer.

3.8 WATER HAMMER ARRESTORS

.1 Install water hammer arrestors complete with an accessible isolation valve on hot and cold water supply piping to:
  .1 Plumbing fixtures and fixture groups,
  .2 Downstream of each backflow preventer,
  .3 HVAC equipment with solenoid valves or other quick closing valves,
  .4 Owner's equipment and appliances with flush valves, solenoid valves or other quick closing valves,
  .5 Wherever necessary to prevent water hammer.

3.9 HAIR AND SEDIMENT INTERCEPTORS

.1 Install interceptors so as to be accessible for cleaning and all other maintenance and repair which may be required.
.2 Make all piping connections. Vent in accordance with Plumbing Code.
.3 Fill with appropriate media as required and turn over spare media to Owner.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 SECTION INCLUDES

.1 Circulators.

1.3 REFERENCES

.1 ASHRAE 90A - Energy Conservation in New Building Design.

1.4 SUBMITTALS FOR REVIEW

.1 Product Data:
- .1 Indicate pump type, capacity, power requirements.
- .2 Controls.
- .3 Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
- .4 Provide electrical characteristics and connection requirements.

.2 Shop Drawings:
- .1 Indicate pump dimensions, sump or tank dimensions, size of tappings.
- .2 Wiring diagrams.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

.1 Project Record Documents: Record actual locations of components.

.2 Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

.3 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

.2 Provide pumps with manufacturer's name, model number, and rating/capacity identified.

.3 Ensure products and installation of specified products are to recommendations and requirements of the following organizations:
- .1 National Sanitation Foundation (NSF).
- .2 American Society of Mechanical Engineers (ASME).
- .3 Canadian Standards Association (CSA)
- .4 National Electrical Manufacturers' Association (NEMA).
- .5 Underwriters Laboratories of Canada (ULC).

.4 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.7 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

.1 Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 WARRANTY

.1 Provide five-year manufacturer warranty for pumps.

1.10 EXTRA MATERIALS

.1 Provide two additional pump seals.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Xylem / Bell & Gosset
.2 Other acceptable manufacturers offering equivalent products.
  .1 S. A. Armstrong
  .2 Darling-Duro
  .3 Grundfos
  .4 Or approved alternate

2.2 DOMESTIC HOT WATER RECIRCULATING PUMP

.1 Type: High Efficiency potable water wet rotor circulator with Electronically Commutated Motor (ECM)
.2 Construction: stainless-steel pump body, impact modified PPE impeller, ceramic/alumina shaft and bearings, 316 stainless steel rotor can, EPDM O-ring. All other wetted parts shall be 316 stainless steel. Insulation Class F
.3 Operating data:
  .1 Maximum working pressure: 145 psi (10 bar)
  .2 Minimum working temperature: 14°F (-10°C)
  .3 Maximum working temperature: 230°F (110°C)
  .4 Ambient temperature range: 32°F (0°C – 10°C)
.4 Features: automatic air purge, one turn knob and multicolour LED display, check valve shipped loose for field operation
.5 Performance: as scheduled
.6 Basis of Design: Xylem/Bell & Gossett Ecocirc XL 36-45

3 EXECUTION

3.1 PREPARATION

.1 Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

.1 Install to manufacturer's instructions.
.2 Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
.3 Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4" (102 mm) and over.
.4 Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
.5 Provide air cock and drain connection on horizontal pump casings.
.6 Provide drains for bases and seals, piped to and discharging into floor drains.
.7 Check, align, and certify alignment of base mounted pumps prior to start-up.
.8 Lubricate pumps before start-up.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 SECTION INCLUDES

.1 Pipe, pipe fittings, valves, and connections for piping systems.
  .1 Sanitary Drain & Vent
  .2 Storm Drain
  .3 Domestic (Potable) Water.
  .4 Condensate Drain
.2 Disinfection of potable water distribution system.
.3 Testing and reporting results.

1.3 REFERENCES

.1 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
.2 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
.3 ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
.4 ASME B16.26 - Copper Alloy Bronze Fittings for Flared Copper Tubes.
.5 ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
.6 ASME B16.32 - Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems.
.7 ASTM A74 - Cast Iron Soil Pipe and Fittings.
.8 ASTM B32 - Solder Metal.
.9 ASTM B42 - Seamless Copper Pipe, Standard Sizes.
.10 ASTM B68 - Seamless Copper Tube, Bright Annealed.
.11 ASTM B75 - Seamless Copper Tube.
.12 ASTM B88 - Seamless Copper Water Tube.
.13 ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
.14 ASTM B302 - Threadless Copper Pipe, Standard Sizes.
.15 ASTM B306 - Copper Drainage Tube (DWV).
.16 ASTM C1053 - Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
.17 ASTM D2239 - Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
.18 ASTM D2241 – Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
.19 ASTM D2447 - Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
.20 ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
.21 ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
.22 ASTM D2665 - Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
.23 ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
.24 ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.
.25 ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
.26 ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
.27 ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
.28 ASTM F679 - Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
.29 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
.30 AWWA C110 - Ductile - Iron and Gray - Iron Fittings, 3" - 48" (76 mm - 1219 mm), for Water.
.31 AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
.32 AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.
.33 AWWA C651 - Disinfecting Water Mains.
.34 AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe (and Fabricated Fittings), 4" - 12" (100 mm - 300 mm), for Water Distribution.
.35 AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2" - 3" (13 mm - 76 mm) for Water Service.
.36 AWWA C902 - Polybutylene (PB) Pressure Pipe and Tubing, 1/2" - 3" (13 mm - 76 mm) for Water.
.37 AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14" - 48" (350 mm -

1200mm).

.38 CISPI 301 - Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.

.39 CISPI 310 - Joints with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

.40 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

.41 MSS SP69 - Pipe Hangers and Supports - Selection and Application.

.42 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

.43 NSF 61 - Drinking Water System Components – Health Effects.

.44 NSF 372 - Drinking Water System Components – Lead Content.

1.4 SUBMITTALS FOR REVIEW

.1 Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

.1 Project Record Documents: Record actual locations of valves.

1.6 QUALITY ASSURANCE

.1 Perform Work to Province of Ontario standards. Maintain one copy on site.

.2 Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.7 REGULATORY REQUIREMENTS

.1 Perform Work to Province of Ontario plumbing code.

.2 Conform to applicable code for installation of backflow prevention devices.

.3 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.8 DELIVERY, STORAGE, AND PROTECTION

.1 Accept valves on site in shipping containers with labeling in place. Inspect for damage.

.2 Provide temporary protective coating on cast iron and steel valves.

.3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Do not install underground piping when bedding is wet or frozen.

1.10 EXTRA MATERIALS

.1 Provide two repacking kits for each size valve.

2 PRODUCTS

2.1 SANITARY DRAIN AND VENT PIPING, BURIED WITHIN 1500 mm (5 FEET) OF BUILDING

.1 Cast Iron Pipe: ASTM A74 extra heavy weight.

.1 Fittings: Cast iron.

.2 Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

.2 Cast Iron Pipe: CISPI 301, hubless.

.1 Fittings: Cast iron.

.2 Joints: CISPI 310, neoprene gasket and stainless-steel clamp and shield assemblies.
.3 Copper Tube: ASTM B306, DWV.
.1 Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
.2 Joints: ASTM B32, solder, Grade 50B.
.4 PVC Pipe: ASTM D2665 or ASTM D3034.
.1 Fittings: PVC.
.2 Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
.5 PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
.1 Fittings: PVC.
.2 Joints: ASTM F477, elastomeric gaskets.
.6 Piping, fittings and joints used in pressure sewer, force main or sump pump discharge applications shall be capable of withstanding at least one and one-half times the maximum potential pressure.

2.2 SANITARY DRAIN AND VENT PIPING, ABOVE GRADE

.1 Cast Iron Pipe: ASTM A74, service weight.
.1 Fittings: Cast iron.
.2 Joints: ASTM C564, neoprene gasket system
.2 Cast Iron Pipe: CISPI 301, hubless, service weight.
.1 Fittings: Cast iron.
.2 Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
.3 Copper Tube: ASTM B306, DWV.
.1 Fittings: ASME B16.23, cast copper alloy, or ASME B16.29, wrought copper, or ASME B16.32, solvent.
.2 Joints: ASTM B32, solder, Grade 50B.
.4 IPEX System XFR DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25 and Smoke Developed Classification not more than 50.
.1 PVC Solvent Weld:
.1 IPEX System 15/System XFR One-Step PVC Cement certified to CSA B181.2.
.2 IPEX System 15/System XFR Two-Step PVC Cement certified to CSA B181.2.
.3 IPEX System 15/System XFR PVC Primer certified to CSA B181.2.
.1 Sizes 1-1/2 inch to 6 inch: One-Step PVC Cement.
.2 Sizes 8 inch and above: Two-Step PVC Cement with PVC Primer.
.2 Mechanical Joint Couplings:
.1 IPEX MJ GREY DWV certified to CAN/CSA B602 and having a Flame Spread Rating not more than 25 and Smoke Developed Classification not more than 50.
.5 Piping, fittings and joints used in pressure sewer, force main or sump pump discharge applications shall be capable of withstanding at least one and one-half times the maximum potential pressure.

2.3 STORM DRAIN PIPING, BURIED WITHIN 1500 mm (5 FEET) OF BUILDING

.1 Cast Iron Pipe: ASTM A74 extra heavy weight.
.1 Fittings: Cast iron.
.2 Joints: ASTM C564, neoprene gasket system or lead and oakum.
.2 Cast Iron Pipe: CISPI 301, hubless, service weight.
.1 Fittings: Cast iron.
.2 Joints: Neoprene gaskets and stainless-steel clamp-and-shield assemblies.
.3 PVC Pipe: ASTM D2665 or ASTM D3034.
.1 Fittings: PVC.
.2 Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
.4 PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
.1 Fittings: PVC.
.2 Joints: ASTM F477, elastomeric gaskets.

2.4 STORM DRAIN PIPING, ABOVE GRADE

.1 Cast Iron Pipe: ASTM A74 extra heavy weight.

.1 Fittings: Cast iron.
.2 Joints: ASTM C564, neoprene gasket system or lead and oakum.

.2 Cast Iron Pipe: CISPI 301, hubless, service weight.
.1 Fittings: Cast iron.
.2 Joints: Neoprene gaskets and stainless-steel clamp-and-shield assemblies.

.3 IPEX System XFR DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25 and Smoke Developed Classification not more than 50.
.1 PVC Solvent Weld:
.1 IPEX System 15/System XFR One-Step PVC Cement certified to CSA B181.2.
.2 IPEX System 15/System XFR Two-Step PVC Cement certified to CSA B181.2.
.3 IPEX System 15/System XFR PVC Primer certified to CSA B181.2.
.1 Sizes 1-1/2 inch to 6 inch: One-Step PVC Cement.
.2 Sizes 8 inch and above: Two-Step PVC Cement with PVC Primer.
.2 Mechanical Joint Couplings:
.1 IPEX MJ GREY DWV certified to CAN/CSA B602 and having a Flame Spread Rating not more than 25 and Smoke Developed Classification not more than 50.

2.5 WATER PIPING, BURIED WITHIN 1500 mm (5 FEET) OF BUILDING (POTABLE AND NON-POTABLE)

.1 Copper Tubing: ASTM B42, hard drawn.
.1 Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
.2 Joints: AWS A5.8, BCuP silver braze.

.2 Copper Tubing: ASTM B42, annealed.
.1 Fittings: ASME B16.26, cast bronze.
.2 Joints: Flared.

.3 Ductile Iron Pipe: AWWA C151.
.1 Fittings: Ductile iron, standard thickness.
.2 Lining: cement
.3 Joints: AWWA C111, rubber gasket with 3/4" (19 mm) diameter rods.

2.6 WATER PIPING, ABOVE GRADE (POTABLE AND NON-POTABLE)

.1 Copper Piping: ASTM B88M, Type L, hard drawn.
.1 Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze. Grooved end fittings shall be manufactured to copper-tube dimensions. (Flaring the adjoining tube or fitting ends to accommodate alternate sized couplings is not permitted.)
.2 Joints:
.1 ASTM B32, lead free, solder, Grade 95TA.
.2 Installation-ready grooved joint couplings.
.3 UL classified in accordance with ANSI / NSF-61 for potable water service, and shall be certified to the low lead requirements of NSF-372.

.2 Copper Tubing: ASTM B88M, Type L, hard drawn.

.3 Stainless Steel Pipe: ASTM A312, Schedule 10S, Type 316/316L stainless steel with grooved ends is an acceptable alternative where accepted by authorities having jurisdiction.

.4 Ductile Iron Pipe: AWWA C151.
.1 Fittings: Ductile iron, standard thickness.
.2 Lining: cement
.3 Joints: AWWA C111, rubber gasket with 3/4" (19 mm) diameter rods.

2.7 CONDENSATE PIPING

.1 Copper Tubing: 3/4" (20mm) and 1" (25mm) type M. 1-1/4" (32mm) and larger annealed copper tubing, type DWV, to ASTM B306. Iron Pipe: ASTM A74 extra heavy weight.
.1 Fittings: ANSI B16.29, wrought copper or copper alloy drainage fittings or ANSI B158.1 cast brass fittings.
.2 Joints: ASTM B32, solder, grade 50B.

2.8 FLANGES, UNIONS, AND COUPLINGS

.1 Pipe Size 3-1/4" (80 mm) and Under:
  .1 Ferrous pipe: Class 150 malleable iron threaded unions.
  .2 Copper tube and pipe: Class 150 bronze unions with soldered joints.
.2 Pipe Size Over 1" (25 mm):
  .1 Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
  .2 Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
.3 Grooved and Shouldered Pipe End Couplings:
  .1 Housing: Two ductile iron clamps to engage and lock, designed with offsetting angle-pattern, bolt pads; ASTM A449 electroplated steel bolts, nuts, and washers; galvanized for galvanized pipe.
  .2 Sealing gasket: "C" shape composition sealing gasket.
  .3 Installation-Ready, for direct stab installation without field disassembly.
  .4 Standard of Acceptance: Victaulic Style 607H.
.4 Dielectric Connections:
  .1 Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
  .2 Waterway Fitting: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372. Basis of Design: Victaulic Series 647.

2.9 PIPE HANGERS AND SUPPORTS

.1 Plumbing Piping - Drain, Waste, and Vent:
  .1 Conform to ASME B31.9.
  .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
  .3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
  .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  .5 Wall Support for Pipe Sizes to 3-1/4" (80 mm): Cast iron hook.
  .6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
  .7 Vertical Support: Steel riser clamp.
  .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
.2 Plumbing Piping - Water:
  .1 Conform to ASME B31.9.
  .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
  .3 Hangers for Cold Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
  .4 Hangers for Hot Pipe Sizes 2" to 4" (50 to 100 mm): Carbon steel, adjustable, clevis.
  .5 Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
  .6 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
  .7 Multiple or Trapeze Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
  .8 Wall Support for Pipe Sizes to 3-1/4" (80 mm): Cast iron hook.
  .9 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
  .10 Wall Support for Hot Pipe Sizes 6" (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron pipe roll.
  .11 Vertical Support: Steel riser clamp.
  .12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  .13 Floor Support for Hot Pipe Sizes to 4" (100 mm): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

.14 Floor Support for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
.15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.10 VALVES - GENERAL

.1 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
.2 Specification MSS-SP-80, MSS-SP-110, MSS-SP-70, 85, 71, MSS-SP-72, MSS-SP-67.
.3 Provide valves of the same manufacturer where possible.
.4 Use the following valves for all piping systems provided by this Section, unless specified otherwise.
.5 Use rising stem where space permits. Use flanged, screwed or solder ends to suit pipe lines, and non-heating malleable iron handles.
.6 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.
.7 Valid CRN (Canadian Registration Number) issued by Province of Ontario required for each valve.
.8 Materials:
.1 Bronze: ASTM C89530 and C87800 Lead Free Bronze
.2 Brass: ASTM C46750 and C27450 Lead Free Brass
.3 Cast Iron: ASTM A126 Class B
.4 Stainless Steel: ASTM A351 Grade CF8M
.9 End Connections:
.1 Flanged ends: ANSI B16.1 (Class 125), ANSI B16.5
.2 Face-to-face dimensions: ANSI B16.10
.3 Grooved ends: CSA B242; copper-tube dimensions.
.10 Design and Testing:
.1 Bronze Gate & Check valves: MSS-SP-80
.2 Ball Valves: MSS-SP-110
.3 Cast Iron Gate Valves: MSS-SP-70
.4 Cast Iron Globe Valves: MSS-SP-85
.5 Cast Iron Check: MSS-SP-71
.6 Ball Valves: MSS-SP-72
.7 Butterfly Valves: MSS-SP-67
.8 High Performance Butterfly API-609
.11 First named product as indicated in paragraphs below; other acceptable manufacturers, subject to equivalent products listed on spread sheet attached.

2.11 ISOLATION VALVES

.1 Up To and including 2" (50mm) - Ball type
.1 Manufacturer: Kitz #859, Toyo Red & White 5049A-LF or approved alternate
.2 Construction: MSS SP-110, Class 150, 600 psi (4140 kPa) CWP, ASTM C46750 forged Lead Free brass, two piece body, SiNi plated or stainless steel ball, full port, virgin PTFE seats, Glass filled PTFE stem packing or Double O Ring design, blow-out proof stem, lever handle with memory balancing stops, stem extensions for insulated piping, solder ends.
.2 2-1/2" (65 mm) and Larger - Butterfly type:
.1 Manufacturer: Kitz 6122EL, MAS L-D-4-A-E-L or approved alternate
Construction: NSF 372 Certified, MSS-SP-67, MSS-SP-25 and API-609; lug type having bi-directional "Dead End Service" pressure rating of 1380 kPa (200 psi) with the downstream flange removed; stainless steel stem with top and bottom bushings of dissimilar materials and with positive stem retention mechanism, aluminum bronze disc and molded/bonded or cartridge style EPDM seat; suitable for both chilled water and hot water operation; supplied with 10 position locking lever handle 2" extended neck to allow for insulation. Provide gear operators for valves 150 mm and larger, and chain-wheel operators for valves mounted over 8-Ft (2400 mm) above floor.
.2 Manufacturer: Victaulic Series 608N or approved alternate
Construction: Copper-tube dimensioned grooved end body having a bi-directional "Dead End Service" pressure rating of 2065 kPa (300 psi); stainless steel stem (stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating), aluminum-bronze

disc, and pressure-responsive elastomer seat, UL classified in accordance with ANSI / NSF-61 for potable water service, and shall be certified to the low lead requirements of NSF-372. Supplied with a lever handle or gear operator (as required 150 mm and larger) with mounting brackets and extended stem. Use grooved end valves in grooved piping systems.
Construction: Stainless steel for use in stainless steel piping 2" – 8" / 50 – 200 mm: 300 psi (2068 kPa CWP), suitable for bi-directional and dead-end service to full rated pressure. Grooved end stainless steel body and disc, grade CF8M, conforming to ASTM A351, with blow-out proof 17-4PH stainless steel stems to ASTM A564. Disc shall be connected to the stem without the use of fasteners or pins, and be offset from the disc centerline to provide a full 360° continuous contact with the seating surface when closed. Seat shall be pressure responsive, EPDM. Stem seals shall be of the same material as the seats. Valve shall have standard ISO flange mounting for ease of actuation. Valve supplied with lever handle or gear operator (as required 150 mm and larger). The handle shall be zinc-plated carbon steel or fully stainless steel, latch lock type with infinitely variable and memory stop features. Manufacturer – Victaulic Series 461 Vic-300 MasterSeal Valve. Use grooved end valves in grooved piping systems.

.3 2-1/2" (65 mm) and Larger – Ball type:
- .1 Manufacturer: Kitz 150UTDZM-N, MAS F-150-SS-F-N or approved alternate
- .2 Construction: ANSI Class 150, A351 CF8M Stainless Steel Body, Stainless Steel Ball & Stem, PTFE Packing, Hypatite or PTFE Seats, Full Port, Flanged Ends. Lever Handle 2" (50 mm) – 4" (100 mm), Provide Gear Operated 6" (150 mm) and Larger. Chain wheel operators for valves mounted over 8-Ft (2400 mm) above floor.

.4 2-1/2" (65 mm) and Larger – High Performance Butterfly type:
- .1 Manufacturer: WKM B5123-02-S02-11HL/WG or approved alternate
- .2 Construction: API-609, ANSI Class 150, Lug-style A351 CF8M Stainless Steel Body, 17-4 stainless steel shaft, stainless steel disk, and RTFE packing and seat. Valve disk rotational axis shall be double-offset from the centreline of the valve. Valve shall be bi-directional and capable of bubble-tight shut-off to the full ASME rating without the downstream flange connected. Provide gear operators for valves 6" (150 mm) and larger, and chain-wheel operators for valves mounted over 8-Ft (2400 mm) above floor

2.12 THROTTLING VALVES

.1 Up To and including 2" (50 mm) - Globe type:
- .1 Manufacturer: Kitz 812, Toyo Red & White 212-LF or approved alternate
- .2 Construction: MSS SP-80, 860 kPa (125psig) 200 WOG, bronze body to ASTM C89530, screwed bonnet, inside screw, Graphite packing, Bronze disk, solder ends.

.2 Up To and including 2" (50 mm) – Balancing Valve type:
- .1 Manufacturer: RWV 9517-AB Threaded, RWV 9519-AB Solder or approved alternate
- .2 Construction: MSS SP-80, 2068 kPa (300psig) 300 WOG Rating, lead free brass body, fixed orifice design for constant Cv, Double regulating +/-3% accuracy, Precision Adjustable Handwheel, Integral Memory Stop.

.3 2-1/2" (65 mm) and Larger - Globe type:
- .1 Manufacturer: Kitz 150 UPAM (Globe) or approved alternate
- .2 Construction: A351 CF8M(Cast 316 SS) Body, ANSI Class 150, Trim 10, PTFE packing, OS&Y, Flanged.

.4 2-1/2" (65 mm) and Larger - Butterfly type
- .1 Manufacturer: Kitz 6122EL, MAS L-D-4-A-E-L or approved alternate
- .2 Construction: NSF 372 Certified, MSS-SP-67, MSS-SP-25 and API-609; lug type having bi-directional "Dead End Service" pressure rating of 1380 kPa (200 psi) with the downstream flange removed; stainless steel stem with top and bottom bushings of dissimilar materials and with positive stem retention mechanism, aluminum bronze disc and molded/bonded or cartridge style EPDM seat; suitable for both chilled water and hot water operation; supplied with 10 position locking lever handle 2" extended neck to allow for insulation. Provide gear operators for valves 150 mm and larger, and chain-wheel operators for valves mounted over 8-ft (2400 mm) above floor.

2.13 CHECK VALVES

.1 Up To and Including 2" (50 mm):
.1 Swing “Y” Pattern:
Screwed Ends - Kitz 822, Toyo Red & White 236A-LF or approved alternate
Solder Ends - Kitz 823, Toyo Red & White 237A-LF or approved alternate
Construction: MSS SP-80, 860 kPa (125 psig) / 200 W.O.G. bronze body to ASTM C89530 (Lead Free Bronze), Screwed Cap C46750 (Lead Free Brass), Integral Brass Seat.
.2 Spring Loaded:
Screwed Ends – Mueller Steam Specialty Model 303HT or approved alternate
Construction: Body/Cap/Disc Stainless Steel ASTM A351 CF8M, Guide Pin 420 SS, Seal Viton, Gasket Compressed Fiber, Spring 304 Stainless Steel.
Not for use with reciprocating compressors or pumps.
Not for use in sewage ejector piping.
.2 2-1/2" (65 mm) and Larger:
.1 Swing Check Flanged - Kitz 150UOAM or approved alternate
Construction: ANSI Class 150 Stainless Steel A351 CF8M(Cast 316 SS) Body, Trim #10, Bolted Cover, PTFE Gasket, Flanged.
.2 Wafer Checks - Single Flapper – Moygro W15A-666 or approved alternate
Construction: Stainless Steel A351 CF8M Body, ANSI Class 150, 316 SS Trim or approved alternate
.3 Double Door – Mueller Steam Specialty Model 72H-HHH-H-H or approved alternate
Construction: Stainless Steel A351 CF8M Body, ANSI Class 150, 316 SS Trim or approved alternate
.4 Silent Check – Spring Loaded – Mueller Steam 101MHT / Mueller Steam 105MHT (Globe Style) or approved alternate
Construction: Stainless Steel A351 CF8M Body, Class 150, 316 SS Trim, Center Guided
.3 Note: Check valves minimum installation 8-10 pipe diameters downstream of pumps is recommended.

2.14 CIRCUIT BALANCING VALVES

.1 Circuit Balancing Valves: 2” (50MM) and smaller:
.1 Screwed connection, globe valve type, fixed orifice design, brass body, high and low pressure metering points, full shutoff, precision position indicator windows, topset handwheel assembly.
.2 Provide valves suitable for maximum working pressure of 300 PSI (2 mPa) and maximum operating temperature of 160 deg. F (70 deg. C).
.3 Acceptable Products: MA Stewart RWV 9517 or approved alternate

2.15 DRAIN VALVES

.1 ½” and ¾” – Ball Cap & Chain type:
.1 Manufacturers:
Threaded Ends: Kitz 868C, Toyo Red & White 5046-LF or approved alternate
Solder Ends: Kitz 869C or approved alternate
.2 Construction: 150 psig (1034 kPa), 600 WOG, MSS SP-110, ASTM C46750 forged Lead Free brass, two piece body, SiNi plated ball, full port, virgin PTFE seats, Glass filled PTFE stem packing or Double O Ring design, blow-out proof stem, lever handle with cap and chain, (3/4") 20 mm hose connection.

2.16 WATER PRESSURE REDUCING VALVES

.1 Up to 2" (50 mm):
.1 Manufacturers:
.1 Armstrong Model GD 24.
.2 Watts Model Series 223.
.3 or approved alternate
.2 MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded ends.
.2 Over 2" (50 mm):
.1 Manufacturers:

.1 Armstrong Model GD 200.200H.
.2 Watts Model Series N223.
.3 or approved alternate

.2 MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.17 RELIEF VALVES

.1 Pressure Relief:
.1 Manufacturers:
.1 Watts Model Series 40.
.2 or approved alternate
.2 AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

2.18 STRAINERS

.1 Up to 200 psig:
.1 Size 2" (50 mm) and Under:
.1 Manufacturers: Mueller Steam LF351 or approved alternate
.2 Construction: 860 kPa (125 psig) 200 WOG Rating, ASTM C87800 Lead Free Bronze body, Screwed Cap, Y Pattern, 304 stainless steel screen with 20 Mesh perforation, Threaded Ends.
.2 Size 2-1/2" (65 mm) and larger:
.1 Manufacturers: Mueller Steam 781 SS or approved alternate
.2 Construction: ANSI Class 150 A351 CF8M (Cast 316SS) Body, Bolted Cover, Y Pattern, 304 stainless steel screen with 1/32 perforation, Flanged Ends.
.2 Up to 250 psig:
.1 Size 2" (50 mm) and Under:
.1 Manufacturers: Mueller Steam LF352 or approved alternate
.2 Construction: Class 250, 400 psig WOG, ASTM C87800 Lead Free Bronze body, Y-pattern, screwed cap and ends, 304 stainless steel screen with 20 Mesh perforation, Threaded Ends.
.2 Size 2-1/2" (65 mm) and larger:
.1 Manufacturers: Mueller Steam 781 SS or approved alternate
.2 Construction: ANSI Class 150 A351 CF8M (Cast 316SS) Body, Bolted Cover, Y Pattern, 304 stainless steel screen with 1/32 perforation, Flanged Ends.

2.19 DISINFECTION CHEMICALS

.1 Chemicals: AWWA B300, Hypochlorite,

3 EXECUTION

3.1 EXAMINATION

.1 Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

.1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
.2 Remove scale and dirt, on inside and outside, before assembly.
.3 Prepare piping connections to equipment with flanges or unions.
.4 Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as disconnect points if required.)

3.3 INSTALLATION

.1 Install to manufacturer's instructions.

.2 Grooved Joints: Install in accordance with the manufacturer's latest published installation instructions. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

.3 Provide non-conducting dielectric connections wherever jointing dissimilar metals.

.4 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

.5 Install piping to maintain headroom, conserve space, and not interfere with use of space.

.6 Group piping whenever practical at common elevations.

.7 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

.8 Pressure test piping for a minimum of four (4) hours. Testing shall be carried out at a pressure of 1.5 times operating pressure or 125 psi, whichever is greater.

.9 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

.10 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with general trades.

.11 Establish elevations of buried piping outside the building to ensure not less than 5'6" (1.6 m) of cover.

.12 Install vent piping penetrating roofed areas to maintain integrity of roof assembly; coordinate with Division 07.

.13 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer (maximum VOC content of 80 g/L) to welding.

.14 Provide support for utility meters to requirements of utility companies.

.15 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting where required. Coordinate with general trades.

.16 Excavate and backfill as required for work of this Section.

.17 Install bell and spigot pipe with bell end upstream.

.18 Install valves with stems upright or horizontal, not inverted.

.19 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

.20 Sleeve pipes passing through partitions, walls and floors.

.21 Inserts:

- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4" (100 mm).
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

.22 Pipe Hangers and Supports:

- .1 Install to OBC (Plumbing Code)
- .2 Support horizontal piping as scheduled.
- .3 Install hangers to provide minimum 1/2" (15 mm) space between finished covering and adjacent work.
- .4 Place hangers within 12" (300 mm) of each horizontal elbow.
- .5 Use hangers with 1-1/2" (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- .6 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Provide copper plated hangers and supports for copper piping.
- .9 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

.10 Provide hangers adjacent to motor driven equipment with vibration isolation.
.11 Support cast iron drainage piping at every joint.

3.4 UNDERGROUND WATER MAINS

.1 Install pipes to bear throughout their full length. Do not support piping by the bell ends only or by blocks.
.2 Anchoring of Mains: Provide pipe clamps and tie-rods, thrust blocks, locked mechanical or push-on mechanical joints utilizing set screw retainer glands or other approved methods or devices.
.3 Sizing clamps, rods, bolts & washers.
.1 Clamps: 1/2" x 2" (12.7 x 50 mm) for pipe 6" (150 mm) and smaller
.2 Rods: minimum size of 5/8" (16 mm)
.3 Clamp bolts: minimum 5/8" (16 mm)
.4 Washers: minimum 5/8" x 3" (16 x 75 mm) cast iron or steel, round or square.
.4 Sizing of anchor straps for tees: minimum 5/8" (16 mm) thick by 2-1/2" (62 mm) wide.
.5 Sizing of plug strap for bell end pipe: minimum 3/4" (20 mm) thick by 2-1/2" (62 mm) wide.
.6 Clean all bolted joint accessories thoroughly and coat with asphalt or other corrosion retarding material after installation.
.7 Thrust Blocks:
.1 Provide at each change in direction of pipeline and at all tees, plugs, caps, and bends.
.2 Use a concrete mix not leaner than one part cement, two and one-half parts sand, and five parts stone. Place backing between undisturbed earth and fitting to be anchored.
.3 In general, place backing so that the joints shall be accessible for inspection and repair.
.8 Area of Bearing Face of Concrete Thrust Blocks

PIPE SIZE	1/4 BEND		1/8 BEND		TEES, PLUGS, CAPS AND HYDRANTS	
	SQ. FT.	SQ. M	SQ. FT.	SQ. M	SQ. FT.	SQ. M
4”	2	0.19	2	0.19	2	0.19
6”	5	0.46	3	0.28	4	0.37
8”	8	0.74	5	0.46	6	0.56
10”	13	1.21	7	0.65	9	0.84
12”	18	1.67	10	0.93	13	1.21

.9 The above bearing face areas are based on undisturbed soil. Use the following multiplying factors for the following ground conditions:
.1 Soft Clay 4.0
.2 Sand 2.0
.3 Sand & Gravel 1.3
.4 Shale 0.4
.10 Do hydrostatic testing prior to backfilling over joints.
.11 Backfilling: backfill as indicated. In addition, puddle where possible to prevent settlement or lateral movement.
.12 Install ductile iron pipe and fittings in accordance with AWWA C600, Standard for installation of Ductile Iron and Cast-Iron Watermains. Provide minimum frost cover for watermain 5'-6" (1600 mm).
.13 Stretch copper tube installed underground until it is straight and every bend made in it thereafter shall be made with tools designed for the purpose of bending with constant radius. Provide minimum frost cover for watermain of 5'-6" (1600 mm).
.14 Water main shall be brought into building to a point 12" (310 mm) above floor, capped with a blank flange by trades doing outside services.

3.5 UNDERGROUND SEWER LINES

.1 Arrange for and coordinate the installation of the storm and sanitary sewer connections with the municipal authority.

.2 Provide qualified personnel to properly layout and establish all lines and grades necessary for construction. Accurately verify location and inverts of all existing services before any sewer work is started to ensure that connection of new sewers to existing can be made. Construct and maintain adequate batter boards, alignment markers and secondary benchmarks as may be required for proper execution of work.

.3 Batter boards or sight lines shall be set not more than 25 ft. (7.5 m) apart. A minimum of three (3) batter boards shall be in place at all times during laying operation.

.4 Notify Consultant of any layout work to be carried out, Consultant shall have right to check Contractor's layout at any time, but checking layout or failure to do so on part of Consultant in no way relieves Contractor of full responsibility for construction to exact alignment and grade.

.5 Verify all existing invert elevations before setting out drainage work.

.6 Sewer lines, connections shall be built to exact lines and grades as shown on drawings. No deviation from these lines and grades shall be permitted unless approved in writing by Consultant.

.7 Where pipes enter or leave manhole or other structure, support them on compacted crushed stone bed or concrete cradle through the backfill area. The pipe support shall extend laterally from undisturbed soil to the face of wall through which the pipes pass.

.8 Install precast manholes and catch basins or cast-in-place concrete manholes and catch basins, as indicated where required.

.9 Form concrete benching in sanitary manholes to provide a smooth unobstructed flow channel in the bottom of manhole with slopes of 1" per foot (100 mm/m). Storm manholes shall have 24" (600 mm) sumps unless instructed otherwise by the Consultant or local authority.

.10 Completely surround plastic piping by at least 4" (100 mm) of non-cohesive ballast material of which at least 50% shall pass a 1/4" (6.35 mm) sieve and 100% shall pass a 1/2" (12.7 mm) sieve, and that is sufficiently consolidated so that the intended earth loading shall not produce further compaction.

.11 Install Big "O" BOSS 2000 storm sewer system in accordance with BOSS 2000 Gravity Sewer Installation Guide and ASTM D2321. Perform all bedding, haunching and backfilling as required.

3.6 APPLICATION

.1 Use grooved mechanical couplings and fasteners in accessible locations, risers, and pipe chases. Couplings shall not be used in inaccessible locations.

.2 Install unions downstream of valves and at equipment or apparatus connections.

.3 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

.4 Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

.5 Install globe valves for throttling, bypass, or manual flow control services.

.6 Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

.7 Provide spring loaded check valves on discharge of water pumps.

.8 Provide plug valves in natural gas systems for shut-off service.

.9 Provide flow controls in water recirculating systems where indicated.

3.7 ERECTION TOLERANCES

.1 Establish invert elevations, slopes for drainage to 2 percent minimum. Maintain gradients.

.2 Slope water piping minimum 0.25 percent and arrange to drain at low points.

3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

.1 Disinfect all new and altered water distribution piping.

.2 Verify that piping system is complete and has been flushed, cleaned, inspected, and pressure tested.

.3 Isolate existing piping to full extent possible. Ensure that all fixtures, exiting and new that are served from piping being disinfected, are taken out of service and signs are placed at each fixture prohibiting use during the disinfection period.

.4 Schedule and perform disinfecting activities with start-up, testing, adjusting, balancing, and demonstration procedures. Coordinate with related systems.

.5 Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

.6 Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

.7 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
.8 Maintain disinfectant in system for 24 hours.
.9 If final disinfectant residual tests less than 25 mg/L, repeat treatment.
.10 Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
.11 Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze to AWWA C651.

3.9 SERVICE CONNECTIONS

.1 Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
.2 Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves pressure reducing valve.

3.10 SCHEDULES

.1 Pipe Hanger Schedule:
- .1 Metal Piping:
  - .1 Pipe size: 1/2" to 1-1/4" (15 to 32 mm):
    - .1 Maximum hanger spacing: 6.5' (2 m).
    - .2 Hanger rod diameter: 3/8" (9 mm).
  - .2 Pipe size: 1-1/2" to 2" (40 to 50 mm):
    - .1 Maximum hanger spacing: 10' (3 m).
    - .2 Hanger rod diameter: 3/8" (9 mm).
  - .3 Pipe size: 2-1/2" to 3" (65 to 75 mm):
    - .1 Maximum hanger spacing: 10' (3 m).
    - .2 Hanger rod diameter: 1/2" (13 mm).
  - .4 Pipe size: 4" to 6" (100 to 150 mm):
    - .1 Maximum hanger spacing: 10' (3 m).
    - .2 Hanger rod diameter: 1/2" (15 mm).
  - .5 Pipe size: 8" to 12" (200 to 300 mm):
    - .1 Maximum hanger spacing: 14' (4.25 m).
    - .2 Hanger rod diameter: 3/4" (22 mm).
  - .6 Pipe size: 14" (350 mm) and Over:
    - .1 Maximum hanger spacing: 20' (6 m).
    - .2 Hanger rod diameter: 1" (25 mm).

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 SECTION INCLUDES

.1 Electric Heat Pump Domestic Water Heaters

1.3 REFERENCES

.1 ASHRAE 90A - Energy Conservation in New Building Design.
.2 ASME Section 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.

1.4 SUBMITTALS FOR REVIEW

.1 Product Data:
  .1 Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
  .2 Provide electrical characteristics and connection requirements.
.2 Shop Drawings:
  .1 Indicate dimensions including clearance requirements, size of tappings, and performance data.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

.1 Project Record Documents: Record actual locations of components.
.2 Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
.3 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with a minimum of three years documented experience.
.2 Ensure products and installation of specified products are to recommendations and requirements of the following organizations:
  .1 National Sanitation Foundation (NSF).
  .2 American Society of Mechanical Engineers (ASME).
  .3 National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
  .4 National Electrical Manufacturers' Association (NEMA).
  .5 Underwriters Laboratories (UL).

1.7 REGULATORY REQUIREMENTS

.1 Conform to ASME Section 8D for manufacture of pressure vessels for heat exchangers.
.2 Conform to ASME Section 8D for tanks.
.3 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

.1 Provide temporary inlet and outlet caps. Maintain caps in place until installation.
.2 Provide ten-year limited tank and parts manufacturer warranty for domestic water heaters.

2 PRODUCTS

2.1 ELECTRIC HEAT PUMP HIGH EFFICIENCY WATER HEATER

.1 General: Self-contained heat pump unit integrated into top of tank, commercial grade, backup electric heating elements, anode rods with stainless steel core, electronic user interface, non-CFC foam insulation, tamper-resistant brass drain valve, CSA certified, ASME rated temperature and pressure relief valve,
.2 Electrical: 208/1/60, 30A.
.3 Basis of Design: A.O. Smith Proline XE
.4 Capacity: refer to schedules on drawings

3 EXECUTION

3.1 INSTALLATION

.1 Install water heaters to manufacturer's instructions and to AGA requirements.
.2 Coordinate with plumbing piping and related fuel piping work to achieve operating system.
.3 Domestic Water Heaters:
.1 Install domestic water heaters with clearance for maintenance and repair without disturbing other installed equipment or piping.
.2 Pipe relief valves and drains to nearest floor drain.
.3 Connect service piping for cold water supply, hot water recirculation complete with pump, and hot water discharge.
.4 Pitch shell for condensate drain to traps.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 SECTION INCLUDES

.1 Water closets, seats, tanks, supplies
.2 Lavatories, faucets, waste, supplies
.3 Stainless steel sinks, faucets, supplies, waste
.4 Pet Grooming Sinks, faucets, supplies, waste
.5 Mop sinks, faucets, spouts, accessories
.6 Washing Machine valve box
.7 Showers, head-arm-flange, valves, accessories

1.3 REFERENCES

.1 ANSI Z124.1 - Gel-Coated Glass-Fibre Reinforced Polyester Resin Bathtub Units.
.2 ANSI Z124.2 - Gel-Coated Glass-Fibre Reinforced Polyester Resin Shower Receptor and Shower Stall Units.
.3 ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.
.4 ARI 1010 - Self-Contained Mechanically Refrigerated Drinking Water Coolers.
.5 ASME A112.6.1 - (Floor Affixed) Supports for Off-the-Floor Plumbing Fixtures for Public Use.
.6 ASME A112.18.1 - Plumbing Fixture Fittings.
.7 ASME A112.19.1 - Enamelled Cast Iron Plumbing Fixtures.
.8 ASME A112.19.2 - Vitreous China Plumbing Fixtures.
.9 ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
.10 ASME A112.19.4 - Porcelain Enamelled Formed Steel Plumbing Fixtures.
.11 ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
.12 CAN/CSA-B45.0 General Requirements for Plumbing Fixtures
.13 CAN/CSA-B45.1 Ceramic Plumbing Fixtures
.14 CAN/CSA-B45.2 Enamelled Cast Iron Plumbing Fixtures
.15 CAN/CSA-B45.3 Porcelain-Enamelled Steel Plumbing Fixtures
.16 CAN/CSA-B45.4 Stainless Steel Plumbing Fixtures
.17 CAN/CSA-B45.10 Hydromassage Bathtubs
.18 CAN/CSA-B45.11 Glass Lavatories
.19 CAN/CSA-B125.1 Plumbing Supply Fittings
.20 CAN/CSA-B125.2 Plumbing Waste Fittings
.21 CAN/CSA-B125.3 Plumbing Fittings
.22 CAN/CSA-B125.6 Flexible Water Connectors

1.4 SUBMITTALS FOR REVIEW

.1 Product Data:
  .1 Provide catalogue illustrations of fixtures,
  .2 sizes,
  .3 rough-in dimensions,
  .4 service sizes (capacities)
  .5 trim,
  .6 finishes.

1.5 SUBMITTALS FOR INFORMATION

.1 Manufacturer's Instructions: Indicate installation methods and procedures.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

.1 Maintenance Data: Include fixture trim exploded view and replacement parts lists.
.2 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum five years documented experience.
.2 Installer Qualifications: trades license with minimum five years documented experience.

1.8 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

1.9 MOCK-UP

.1 Refer to Division 01: Requirements for mock-up.
.2 Provide mock-up of typical bathroom group.
.3 Mock-up may remain as part of the Work, if approved by Consultant.

1.10 DELIVERY, STORAGE, AND PROTECTION

.1 Transport, handle, store, and protect products.
.2 Accept fixtures on site in factory packaging. Inspect for damage.
.3 Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.11 WATER EFFICIENCY

.1 The flow rates of fittings that supply water to a fixture shall not exceed the maximum flow rates at the test pressures listed in Part 7 of the Ontario Building Code.

.2 The flush cycle for each fixture that is a water closet or urinal, shall not exceed the maximum flush cycle listed in Part 7 of the Ontario Building Code.

2 PRODUCTS

2.1 MANUFACTURERS

.1 All plumbing fixtures, fixture trim and accessories shall be products of one manufacturer to the extent that this is possible.
.2 Water Closets:
  .1 Vitreous China fixtures: American Standard
    .1 Manufacturer:
    .2 Other acceptable manufacturers offering equivalent products.
      .1 Kohler
      .2 Toto
      .3 Eljer
      .4 Mansfield
      .5 Or approved alternate
  .2 Seats
    .1 Manufacturer: Centoco
    .2 Other acceptable manufacturers offering equivalent products.
      .1 Benecke
      .2 Olsonite
      .3 Bemis
      .4 Or approved alternate

.3 Lavatory:
.1 Lavatory
.1 Manufacturer: American Standard
.2 Other acceptable manufactures offering equivalent products:
.1 Kohler
.2 Mansfield
.3 Eljer
.4 Acorn
.5 Or approved alternate
.2 Lavatory Faucets
.1 Manufacturer: Delta Commercial
.2 Other acceptable manufacturers offering equivalent products:
.1 Moen
.2 Chicago Faucet
.3 Kohler
.4 Sloan
.5 Or approved alternate
.3 Waste
.1 Manufacturer: Delta Commercial
.2 Other acceptable manufacturer offering equivalent products:
.1 Waltec
.2 Emco
.3 Kohler
.4 McQuire
.5 Zurn
.6 Powers
.7 Or approved alternate
.4 Carriers
.1 Manufacturer: Watts
.2 Other acceptable manufacturer offering equivalent products:
.1 Zurn
.2 J.R. Smith
.3 MIFAB
.4 Or approved alternate
.4 Stainless Steel Sinks:
.1 Sink
.1 Manufacturer: Kindred Commercial
.2 Other acceptable manufacturers offering equipment products
.1 AMI
.2 Elkay
.3 Or approved alternate
.2 Sink Faucet
.1 Manufacturer: Delta Commercial
.1 Moen
.2 Chicago Faucet
.3 Kohler
.4 T&S Brass
.5 Or approved alternate
.5 Mop Sink:
.1 Mop Sink
.1 Manufacturer: Stern Williams
.2 Other acceptable manufacturers offering equivalent products:
.1 Fiat
.2 Zurn
.3 Acorn
.4 Or approved alternate
.2 Mop Sink Faucet

.1 Manufacturer: Delta Commercial
.2 Other acceptable manufacturers offering equivalent products:
.1 Moen
.2 Powers
.3 Chicago Faucet
.4 T&S Brass
.5 Or approved alternate

.6 Showers
.1 Shower Enclosure
.1 Manufacturer: Mirolin
.2 Other acceptable manufacturers offering equivalent products
.1 Kohler
.2 American Standard
.3 Fiat
.4 Or approved alternate
.2 Shower Trim
.1 Manufacturer: Delta Commercial
.2 Other acceptable manufacturers offering equivalent products.
.1 Kohler
.2 Symmons
.3 Moen
.4 American Standard
.5 Powers
.6 Chicago Faucet
.7 Or approved alternate

.7 Washing Machine Valve Box
.1 Manufacturer: Symmons
.2 Other acceptable manufacturers offering equivalent products.
.1 Watts
.2 Or approved alternate

.8 Pet Grooming Sink:
.1 Sink Faucet
.1 Manufacturer: T&S Brass
.2 Other acceptable manufacturers offering equivalent products:
.1 Chicago Faucet
.2 Or approved alternate

2.2 WATER CLOSETS, FLOOR MOUNTED, FLUSH TANK (W1)

.1 Bowl: Floor mounted, two-piece tank type vitreous china, white, elongated rim, low consumption - 4.2 LPF/1.1 GPF, concealed hinges, syphon action, lined tank, no plastic flanges permitted. Minimum MaP test rating of 800

.2 Seat: Solid white plastic, open front, extended back, brass bolts, without cover, commercial heavy-duty.

.3 Supplies: Chrome plated, angle closet supply, lockshield screwdriver slot, stuffing box cartridge, brass supply nipple 1/2" (12.7 mm) OD x 12" (305 mm) long flexible riser stainless steel wall flange.

.4 Manufacturers
.1 Bowl: American Standard Cadet FloWise
.2 Supplies: Delta Commercial 37T1326SD
.3 Seat: Centoco 500STSCC-001
.4 Or approved alternate

2.3 WATER CLOSETS, FLOOR MOUNTED, FLUSH TANK, BARRIER FREE (W2H)

.1 Bowl: Floor mounted, two-piece tank type vitreous china, white, elongated rim, low consumption - 4.2 LPF/1.1 GPF, concealed hinges, syphon action, lined tank, no plastic flanges permitted, barrier free installation.

.2 Seat: Solid white plastic, open front, extended back, brass bolts, with cover for barrier free fixtures.
.3 Supplies: Chrome plated, angle closet supply, lockshield screwdriver slot, stuffing box cartridge, brass supply nipple 1/2" (12.7 mm) OD x 12" (305 mm) long flexible riser stainless steel wall flange.
.4 Manufacturers
.1 Bowl: American Standard Cadet FloWise
.2 Supplies: Delta Commercial 37T1326SD
.3 Seat: Centoco 820 STS.
.4 Or approved alternate

2.4 LAVATORY, COUNTER MOUNT (L1)

.1 Lav: Counter mount, white vitreous china, drilled for faucet, overflow, self-rimming
.2 Faucet: Deck mounted, chrome plated cast brass, Blade hands, 4” centreset, less pop up, vandal resistant, 0.5 gpm aerator.
.3 Waste: 1-1/4" (32mm) O.D., chrome plated cast brass drain with open grid strainer.
.4 Supplies: chrome plated, angle closet supply, lockshield screwdriver slot, stuffing box cartridge, brass supply nipple, 12.7mm (1/2") OD x 305mm (12") long flexible riser, stainless steel wall flange
.5 Manufacturers
.1 Lav: American Standard Cadet 9494.001
.2 Faucet: Moen Commercial 8215F05
.3 Waste: Delta Commercial 33T260
.4 Supplies: Delta Commercial 47T2622SD
.5 Pipe Wrap: McGuire Prowrap Insulation Kit
.6 Or approved alternate

2.5 LAVATORY, WALL HUNG (L2)

.1 Lav: wall hung, white vitreous china, drilled for faucet, overflow
.2 Faucet: Deck mounted, chrome plated cast brass, Blade hands, 4” centreset, less pop up, vandal resistant, 0.5 gpm aerator.
.3 Carrier: Heavy duty Concealed arm carrier with heavy gauge steel uprights with integral welded feet, adjustable epoxy cast iron arms with levelling screws and basin locking device, upper i.e. rod and plated hardware.
.4 Waste: 1-1/4" (32mm) O.D., chrome plated cast brass drain with offset open grid strainer.
.5 Supplies: chrome plated, angle closet supply, lockshield screwdriver slot, stuffing box cartridge, brass supply nipple, 12.7mm (1/2") OD x 305mm (12") long flexible riser, stainless steel wall flange
.6 Manufacturers
.1 Lav: American Standard Decorum 9024.004EC
.2 Faucet: Moen Commercial 8215F05
.3 Waste: Delta Commercial 33T290
.4 Supplies: Delta Commercial 47T2622SD
.5 Or approved alternate

2.6 MOP SINK, MOLDED STONE (MS)

.1 Sink: 32"x32"x12" 5000 PSI (350 kg/cm2) moulded stone sink with 10" high minimum 1" thick walls; cadmium plated cast brass drain body with cast brass locknut and two (2) neoprene gaskets; 302 stainless steel flat strainer, without splash panel, mop hanger bracket, hose and bracket and silicone sealant, stainless steel lip.
.2 Faucet: 8" exposed wall mount service sink faucet, integral stops, rigid pail hook top brace, spout hose and outlet, body mounted vacuum breaker, tamperproof blade handle.
.3 Provide 'P' Trap.
.4 Manufacturers:
.1 Mop Sink: Stern Williams Model SB-702
.2 Accessories: Stern Williams Model T-35, T-40
.3 Fitting: Delta Commercial 28C2384
.4 Or approved alternate

2.7 SINK, 1 COMP, WALLFORM SPOUT (S1)

.1 Bowl: Single compartment, counter mount, 18-gauge, 316 stainless steel, drilled for faucet specified, undercoated, each bowl size 18”x16”x8” nominal size: 20-1/2" x 20" x 8"), 3-1/2" waste strainer.
.2 Faucet: deck mounted ,8" centres, blade handles, vandal resistant flow control aerator, 1.5 gpm, wall form spout, brass construction with chrome plated finish.
.3 Waste: Provide 'P' trap, cast brass 1-1/2" with cleanout open grid strainer, union and escutcheon.
.4 Supplies: chrome plated, angle closet supply, lock shield screwdriver slot, stuffing box cartridge, brass supply nipple, 12.7mm (1/2") OD x 305mm (12") long flexible riser, stainless steel wall flange
.5 Manufacturers
.1 Sink: Franke Commercial LBS6808-316P-1
.2 Faucet: Moen Commercial 8287
.3 Supplies: Delta Commercial 47T2622SD
.4 Or approved alternate

2.8 SINK, 2 COMP, WALLFORM SPOUT (S2)

.1 Bowl: Double compartment, counter mount, 20-gauge, 302 stainless steel, drilled for faucet specified, undercoated, each bowl size 18”x16”x8” nominal size: 39-1/2" x 20-9/16" x 8", 3-1/2" waste strainer.
.2 Faucet: deck mounted ,8" centres, blade handles, vandal resistant flow control aerator, 1.5 gpm, wall form spout.
.3 Waste: Provide 'P' trap, cast brass 1-1/2" with cleanout open grid strainer, union and escutcheon.
.4 Supplies: chrome plated, angle closet supply, lock shield screwdriver slot, stuffing box cartridge, brass supply nipple, 12.7mm (1/2") OD x 305mm (12") long flexible riser, stainless steel wall flange
.5 Manufacturers
.1 Sink: Franke Commercial LBD6808-1/3
.2 Faucet: Moen Commercial 8287
.3 Supplies: Delta Commercial 47T2622SD
.4 Or approved alternate

2.9 LAUNDRY SINK, 1 COMP (S3)

.1 Bowl: Single bowl, brushed stainless steel, 24” x 20” x 9” deep. Cabinet mounted, top mount.
.2 Faucet: deck mount, 8” centres, polished chrome plated finish, cast brass body, 8” tubular swing spout, blade handles, pre-rinse spray
.3 Waste: Provide 'P' trap, cast brass 1-1/2" with cleanout open grid strainer, union and escutcheon.
.4 Supplies: chrome plated, angle closet supply, lock shield screwdriver slot, stuffing box cartridge, brass supply nipple, 12.7mm (1/2") OD x 305mm (12") long flexible riser, stainless steel wall flange
.5 Manufacturers
.1 Sink: Franke Commercial DLT 610
.2 Faucet: Delta Commercial 55C1283
.3 Supplies: Delta Commercial 47T2622SD
.4 Or approved alternate

2.10 SHOWER (SH1)

.1 Fitting: Polished chrome plated finish, pressure balance, limit stop for pre-setting maximum temperature, integral volume control, single lever, heavy duty forged brass body.
.2 Shower Head: 1.5 GPM, vacuum breaker
.3 Waste: Provide 'P' trap
.4 Manufacturer:
.1 Fitting & Head: Delta Commercial T13TH182
.2 Rough in: R10000-UNWS
.3 Or approved alternate

2.11 WASHING MACHINE VALVE BOX (WMV)

.1 General: Control valve with triple-seal packing, self-adjusting, spring-loaded, non-wearing action, Flush to wall cover, Slide action on/off control, Solid brass drain pan at outlet, paintable surface, 2" (50 mm)drain outlet, Large metal mounting flanges, Serviceable/replaceable valve, Service stops, Dimensions: Box: 210 x 140 x 96 mm (81/4"x 5-1/2" x 3-3/4") deep, Cover: 235 x 165 mm (9-1/4" x 6-1/2").

.2 Manufacturer:

.1 Symmons W-602-X

.2 Or approved alternate

2.12 EW – EYE/FACE WASH - WALL MOUNTED

.1 Guardian #G1750PGRNT or approved alternate, Wall Mounted, eye/face wash, 11-3/4" (298 mm) diameter, green ABS plastic bowl, two (2) FS-Plus spray heads with flip top dust cover and filter, powder coated cast aluminum flag handle activation, 1/2" (13 mm) IPS chrome plated brass stay-open ball valve with Teflon seal, heavy duty cast aluminum wall bracket with corrosion resistant powder coated finish, chrome plated brass tailpiece and trap with 1-1/2" (38 mm) IPS waste connection, 1-1/4" (32 mm) NPT female outlet

.2 Lawler #911E/F or approved alternate, Emergency Thermostatic Mixing Valve for Eyewash or Eye/Face Wash , lead-free brass and stainless steel design, vandal-resistant temperature adjustment, stainless steel sliding piston control device allow cold flow through both the fixed and variable bypass, 13 mm (1/2") N.P.T. Outlet, positive hot water shut-off, liquid-filled thermostatic motor control mechanism, 29 °C (84.2 °F) factory set temperature, standard 69.8 °F (21 °C) - 89.6 °F (32 °C) temperature range, 26 LPM (6.9 GPM) flow capacity at 30 psi (207 kPa) pressure drop across the valve, 7.57 LPM (2.0 GPM) min. Flow rate, 18 LPM (4.8 GPM) bypass flowrate at 30 psid.

3 EXECUTION

3.1 EXAMINATION AND PREPARATION

.1 Section 20 01 01: Verification of existing conditions before starting work.

.2 Verify that walls and floor finishes are prepared and ready for installation of fixtures.

.3 Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

.1 Rough-in fixture piping connections to minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

.1 Install each fixture with trap, easily removable for servicing and cleaning.

.2 Provide chrome plated rigid supplies to fixtures with screwdriver stops, reducers, and escutcheons.

.3 Install components level and plumb.

.4 Install and secure floor mounted fixtures in place with bolts.

.5 Install and secure wall hung fixtures in place with wall carriers and bolts.

.6 Seal fixtures to wall and floor surfaces with sealant having VOC content not exceeding 250 g/L, colour to match fixture.

.7 Solidly attach water closets to floor with lag screws.

3.4 ADJUSTING

.1 Division 01 - Execution Requirements: Adjusting installed work.

.2 Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

.1 Division 01 - Execution Requirements: Cleaning installed work.

.2 Clean plumbing fixtures and equipment.

3.6 PROTECTION OF FINISHED WORK

.1 Division 01 - Execution Requirements: Protecting installed work.
.2 Do not permit use of fixtures.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 05 14 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Variable Frequency Drives.

1.4 SUBMITTALS

.1 Section 20 01 01: Procedures for submittals.
.2 Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
.3 Manufacturer's Installation Instructions: indicate setting, mechanical connections, lubrication, and wiring instructions.
.4 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 catalog information.
.5 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.
.6 Harmonic filtering. The seller 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 shall 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.
.7 Operating and Maintenance manuals: Include instructions for safe operating procedures and maintenance requirements. Include complete assembly and wiring drawings.

1.5 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacture of variable frequency drives for HVAC use, and their accessories, with minimum ten (10) years documented product development, testing, and manufacturing experience.
.2 To ensure quality and minimize infantile failures at the jobsite, the complete VFD shall be tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.
.3 All optional features shall be functionally tested at the factory for proper operation.

1.6 REGULATORY REQUIREMENTS

.1 Conform to Ontario Electrical Safety Code.
.2 Provide certificate of compliance from authority having jurisdiction indicating approval of variable frequency drives.
.3 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Transport, handle, store, and protect products.
.2 Protect variable frequency drives stored on site from weather and moisture by maintaining factory

covers and suitable weather-proof covering.

1.8 WARRANTY

.1 Refer to Division 01 and Section 20 01 01.
.2 Provide extended coverage five-year warranty for variable frequency drives.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Provide Danfoss VLT FC102 Variable Frequency Drives as per the specifications below and the schedules shown.
.2 Acceptable alternate manufacturers:
  .1 ABB, ACH580
  .2 Allan Bradley.
  .3 Eaton Cutler Hammon
  .4 Toshiba
  .5 Emmerson
  .6 Hitachi
  .7 Yaskawa
  .8 Or approved alternate

2.2 VARIABLE FREQUENCY DRIVES

.1 Furnish complete variable frequency VFDs as specified herein for the fans and pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD shall be housed in a metal NEMA 1 enclosure; The VFD's UL listing shall allow mounting in plenum or other air handling compartments.
.2 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 de-rating.
.3 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. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors shall not draw more than full load current during full load and full speed operation.
.4 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
.5 The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate CSA or C-UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.
.6 The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.
.7 Provide input line reactors to reduce the total harmonic distortion and output filter to limit the dV/dt to 1000 volts / 0.5 microseconds at motor terminals. Their enclosures shall conform to NEMA 1 standards.
.8 The VFD's full load amp rating shall meet or exceed OESC Table 44. 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.
.9 The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without de-rating.

.10 An automatic energy optimization selection feature shall be provided standard 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.
.11 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.
.12 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.
.13 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. VFDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.
.14 VFD power components to be designed for 575VAC. Components designed for 480VAC are not acceptable.
.15 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.
.16 VFD's operating motors not designed to meet NEMA MG1 Part 31 should include Output Load reactors.
.17 VFDs to be complete with integral motor disconnect for OESC Requirements

2.3 PROTECTIVE FEATURES

.1 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.
.2 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.
.3 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.
.4 The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
.5 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).
.6 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.
.7 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.
.8 VFD shall catch a rotating motor operating forward or reverse up to full speed.
.9 VFD shall be rated for 100,000 amp interrupting capacity (AIC).
.10 VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD shall identify which of the output phases is low or lost.
.11 VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230-volt VFDs, 539 V AC on 460 volt VFDs, and 701V AC on 575 volt VFDs.

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 (3 m) away using standard 9-pin cable.
.5 The keypads for all sizes of VFDs shall be identical and interchangeable.

.6 To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs 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 setup 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 and capabilities to be connected at a future date to a BACnet, Johnson Controls N2, Siemens FLN, Lonworks or approved alternate system. The connection shall be software selectable by the user.

.12 As a minimum, the following points shall be controlled and/or accessible:

.1 VFD Start/Stop, Speed reference, Fault diagnostics, and Meter points as follows:

.2 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, Heatsink 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. VFDs 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 shall 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 (°F) 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 176 °F (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 voltages (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.

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, overvoltage, 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 BY-PASS

.1 Provide a manual 3-contactor bypass, consisting of a door interlocked main fused disconnect pad lockable in the off position, a built-in motor starter and a four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the VFD. In the OFF position, the motor and VFD are disconnected. In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass. In case of an external safety fault, a customer supplied normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode.

.2 Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.

2.7 SERVICE CONDITIONS

.1 Ambient temperature, 14° to 104°F (-10° to 40°C).

.2 0 to 95% relative humidity, non-condensing.

.3 Elevation to 3,300 feet (1006 m) without de-rating.

.4 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.

3 EXECUTION

3.1 START-UP SERVICE

.1 The manufacturer shall provide start-up 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.

.2 Adjust and record minimum and maximum speeds to accommodate required design flows and flow variations.
.3 Record internal overload settings on start-up form.

3.2 WARRANTY

.1 The VFD shall be warranted by the manufacturer for a period of 5 years from date of Substantial Performance.
.2 The warranty shall include parts, labour, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.

3.3 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.
.2 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.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 07 13 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Duct work insulation.
.2 Insulation jackets.

1.4 REFERENCES

.1 The American Society of Mechanical Engineers
  .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
  .2 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  .3 ASTM C553 - Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
  .4 ASTM C612 - Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
  .5 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
  .6 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  .7 ASTM E96 - Water Vapour Transmission of Materials.
  .8 ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
  .9 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
.2 North American Insulation Manufacturers Association
  .1 NAIMA National Insulation Standards.
.3 National Fire Protection Association
  .1 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
.4 Sheet Metal and Air Conditioning Contractors National Association
  .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.5 Underwriters Laboratories
  .1 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
.6 The American Society Heating, Refrigeration Air Conditioning Engineers
  .1 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
.7 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
.8 CGSB-Canadian General Standards Board.
.9 CAN/CGSB-51.9 Mineral Fiber Thermal Insulation for Piping and Round Ducting.
.10 CAN/CGSB-51.10 Mineral Fiber Board Thermal Insulation
.11 CAN/CGSB-51.11 Mineral Fiber Thermal Insulation Blanket.
.12 CAN/CGSB-5140 Mineral Insulation, Flexible, Elastomeric, Unicellular, Sheet & Pipe Cover-up.
.13 CAN/CGSB-51-GP-52 Ma Vapor Barrier, Jacket and Facing Material for Pipe, Duct & Equipment Thermal Insulation.
.14 CAN/CG5B-51-GP-53 M Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels of Round Ducts.

1.5 SUBMITTALS FOR REVIEW

.1 Section 20 01 01:
.2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.6 SUBMITTALS FOR INFORMATION

.1 Section 20 01 01:
.2 Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards shall be achieved.
.3 Samples: Submit two samples of any representative size illustrating each insulation type.

1.7 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
.2 Applicator Qualifications: Company specializing in performing the work of this section with minimum 6 years documented experience.

1.8 REGULATORY REQUIREMENTS

.1 Materials: Flame spread/smoke developed rating of 25/50 to the requirements of the Ontario Building Code.

1.9 DELIVERY, STORAGE, AND PROTECTION

.1 Section 20 01 01: Transport, handle, store, and protect products.
.2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
.3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.10 ENVIRONMENTAL REQUIREMENTS

.1 Section 20 01 01: Environmental conditions affecting products on site.
.2 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
.3 Maintain temperature during and after installation for minimum period of 24 hours.

2 PRODUCTS

2.1 GLASS FIBRE, FLEXIBLE

.1 Manufacturers:
  .1 Owens Corning Fiberglas
  .2 Manson
  .3 Knauf Fiber Glass
  .4 Johns Manville
  .5 CertainTEED "Soft Touch" with FSK jacket
  .6 Or approved alternate
.2 Insulation: ASTM C553; flexible, noncombustible blanket.
  .1 'ksi' value: ASTM C518, 0.045 at 24°C (0.31 @ 75.2°F).
  .2 Density: 0.75lb/ft3, 1.01lb/ft3
  .3 Maximum service temperature: 121°C (250°F).
  .4 Maximum moisture absorption: 0.20 % by volume.
.3 Vapour Barrier Jacket:
  .1 Kraft paper with glass fibre yarn and bonded to aluminized film. (FSK)
  .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
  .3 Secure with pressure sensitive tape.

.4 Vapour Barrier Tape:
.1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
.5 Outdoor Vapour Barrier Mastic:
.1 Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.
.6 Tie Wire: Annealed steel, 1/16" (1.5 mm).

2.2 GLASS FIBRE, RIGID

.1 Manufacturers:
.1 Owens Corning Fiberglas Model Vapour-Seal.
.2 Manson
.3 Knauf Fiber Glass
.4 Johns Manville
.5 Or approved alternate
.2 Insulation: ASTM C612; rigid, noncombustible blanket.
.1 'ksi' value: ASTM C518,0.036 at 75.2°F (24°C).
.2 Maximum service temperature: 250°F (121°C).
.3 Maximum moisture absorption: 0.20 percent by volume.
.4 Density: 48 kg/cu m.
.3 Vapour Barrier Jacket:
.1 Kraft paper with glass fibre yarn and bonded to aluminized film.
.2 Moisture vapour transmission: ASTM E96; 0.04 perm.
.3 Secure with pressure sensitive tape.

2.3 ELASTOMERIC INSULATION

.1 Manufacturers:
.1 Armacell APArmaflex
.2 APArmaflex SA
.3 ArmaTuff Laminated Sheets and Rolls
.4 Or approved alternate
.2 Insulation material shall be a flexible, closed-cell elastomeric insulation in sheet form to ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."
.3 Insulation materials shall have a closed-cell structure to prevent moisture from wicking.
.4 Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's, formaldehyde free, low VOC's, fiber free, dust free and shall resist mold and mildew.
.5 Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ULC S102, ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.
.6 Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2-°F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
.7 Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
.8 The material shall be manufactured under an independent third-party supervision testing program covering the properties of fire performance, thermal conductivity and water vapor transmission.

2.4 JACKETS

.1 Mineral Fibre (Outdoor) Jacket: Asphalt impregnated and coated sheet, 2.45 kg/sq m.
.2 PVC Jacket (Indoor):
.1 Jacket: ASTM C921, One piece sheet material.
.1 Minimum Service Temperature: -31°F (-35°C).
.2 Maximum Service Temperature: 150°F (66°C).
.3 Moisture Vapour Transmission: ASTM E96; 0.03 perm inches.
.4 Maximum Flame Spread: ASTM E84; 25 or less.
.5 Maximum Smoke Developed: ASTM E84; 50 or less.

.6 Thickness: 20 mil (0.4 mm) minimum.
.2 Colour: standard off-white OR coloured to suit duct identification.
.3 Covering Adhesive Mastic
.1 Compatible with insulation, maximum VOC content of 50 g/L.
.4 Manufacturer:
.1 Ceel-Co 300 series
.2 Speedline *Smoke Safe*
.3 Or approved alternate
.3 Aluminum Jacket: ASTM B209M.
.1 Thickness: 0.40 mm sheet.
.2 Finish: Smooth.
.3 Joining: Longitudinal slip joints and 2" (50 mm) laps.
.4 Fittings: 0.4 mm thick die shaped fitting covers with factory attached protective liner.
.5 Metal Jacket Bands: 3/8" (10 mm) wide; 0.015" (0.38 mm) thick aluminum.

2.5 ACCESSORIES

.1 Adhesives and finishes shall be as recommended by the insulation manufacturer and shall comply with Section 20 05 00 Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.
.2 Vapor retarder lap adhesive shall be water based, fire retardant.
.3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50 mm) width.
.4 Tie wire shall be of 1/16" (1.5 mm) Ø stainless steel.
.5 Fasteners shall be of 1/8" (4 mm) Ø pins, with 35 mm square clips. Clip length to suit insulation thickness.
.6 Bands shall be 1/2" (12 mm) wide 1/4" (6mm) thick galvanized steel.
.7 Facing shall be of 1" (25 mm) galvanized steel hexagonal wire mesh attached on both faces of insulation.

3 EXECUTION

3.1 EXAMINATION

.1 Verify that ductwork has been tested before applying insulation materials.
.2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 DUCT INSULATION

.1 Insulate new ductwork as follows:

Service	Insulation Type	Thickness
Air supply - Rectangular	rigid	1"
Air supply - Round	flexible	1"
Exhaust within 6' of outside - Rectangular	rigid	3"
Exhaust within 6' of outside - Round	flexible	3"
Fresh air intake - Rectangular	Rigid	3"
Fresh air intake - Round	flexible	3"
Exhaust air plenums	rigid	3"
Ductwork outdoors	rigid	3"
Air supply runouts to terminal units < 10' in length - Rectangular	rigid	1"
Air supply runouts to terminal units < 10' in length - Round	flexible	1"

Duct mounted cooling coils	rigid	1 ½"

Service	Insulation Type	Thickness
Air supply - Rectangular	rigid	25 mm
Air supply - Round	flexible	25 mm
Exhaust within 2m of outside - Rectangular	rigid	75 mm
Exhaust within 2m of outside - Round	flexible	75 mm
Fresh air intake - Rectangular	rigid	75 mm
Fresh air intake - Round	flexible	75 mm
Exhaust air plenums	rigid	75 mm
Ductwork outdoors	rigid	75 mm
Air supply runouts to terminal units < 3m in length - Rectangular	rigid	25 mm
Air supply runouts to terminal units < 3m in length - Round	flexible	25 mm
Duct mounted cooling coils	rigid	40 mm

.2 Inline duct silencers shall be insulated in the same manner as ductwork.

3.3 INSTALLATION

.1 Install duct insulation to TIAC National Installation Standards.
.2 Apply insulation materials, accessories, jackets and finishes in accordance with manufacturer's written instructions and as specified.
.3 Insulated ductwork conveying air below ambient temperature:
  .1 Provide insulation with vapour barrier jackets.
  .2 Finish with tape and vapour barrier jacket.
  .3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  .4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
.4 Insulated ductwork conveying air above ambient temperature:
  .1 Provide with all service jacket.
  .2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
.5 Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces below 10’-0” (3 metres) above finished floor: Finish with PVC jacket.
.6 Exterior Applications: Provide insulation with vapour barrier jacket. Cover with outdoor jacket finished as specified.
.7 External Duct Insulation Application:
  .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
  .2 Secure insulation without vapour barrier with staples, tape, or wires.
  .3 Install without sagging on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.
  .4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.
  .5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 21 13 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25

1.3 SECTION INCLUDES

.1 Pipe and pipe fittings for:
- .1 Heating water piping system
- .2 Equipment drains and overflows

.2 Valves:
- .1 Gate valves
- .2 Globe or angle valves
- .3 Ball valves
- .4 Butterfly valves
- .5 Check valves
- .6 Circuit balancing valves
- .7 Drain valves

1.4 REFERENCES

.1 The American Society of Mechanical Engineers
- .1 ASME - Welding and Brazing Qualifications.
- .2 ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
- .3 ASME B16.5 Pipe Pumps & Fittings.
- .4 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .5 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .6 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- .7 ASME B31.1 - Code for Power Piping.

.2 The American Society for Testing and Materials
- .1 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .2 ASTM A183 Carbon Steel Track Bolts and Nuts.
- .3 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .4 ASTM B32 - Solder Metal.
- .5 ASTM B88 - Seamless Copper Water Tube.
- .6 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .7 ASTM F876 - Crosslinked Polyethylene (PEX) Tubing.
- .8 ASTM F877 - Crosslinked Polyethylene (PEX) Plastic Hot - and Cold - Water Distribution Systems.
- .9 ASTM F-1476-Standard Specification for Performance of Gasketed Mechanical Couplings for use in Piping Applications.

.3 American Welding Society
- .1 AWS A5.8 - Filler Metals for Brazing and Braze Welding.
  AWS D1.1 - Structural Welding Code - Steel.

.4 American Water Works Association
- .1 AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
- .2 AWWA C110 - Ductile - Iron and Grey -Iron Fittings 3 inch - 48 inch (76 mm - 1219 mm), for Water and Other Liquids.
- .3 AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Pressure Pipe and Fittings.
- .4 AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.

.5 American National Standards Institute

.1 ANSI/MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
.2 ANSI/MSS SP69 - Pipe Hangers and Supports - Selection and Application.
.3 ANSI/MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.5 SUBMITTALS

.1 Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturer's catalogue information. Indicate valve data and ratings.
.2 Welders Certificate: Include welder's certification of compliance with ASME SEC 9.
.3 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
.4 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
.2 Installer: Company specializing in performing the work of this section with minimum 3 years documented experience.
.3 Welders: Certify to ASME SEC 9.

1.7 REGULATORY REQUIREMENTS

.1 Conform to ASME B31.1 code for installation of piping system.
.2 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.
.3 Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Accept valves on site in shipping containers with labeling in place. Inspect for damage.
.2 Provide temporary protective coating on cast iron and steel valves.
.3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
.4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Do not install underground piping when bedding is wet or frozen.

1.10 EXTRA MATERIALS

Provide two repacking kits for each size and valve type.

1.11 WARRANTY

.1 PEX Manufacturer's Warranty: Warranty must meet the following conditions:
  .1 PEX tubing shall carry a 25-year non-prorated warranty against failure due to defect in material and workmanship, beginning with date of substantial completion.
  .2 Manifolds and fittings shall carry a 5-year non-prorated warranty against failure due to defect in material and workmanship, beginning with date of substantial completion.
  .3 Warranty shall provide for repair and or replacement of any tube or fittings which are proven to be defective and pay for consequential damage.

2 PRODUCTS

2.1 VALVES - GENERAL

.1 Manufacturers:
- .1 Kitz.
- .2 Crane
- .3 Conbraco.
- .4 Nibco
- .5 Jenkins
- .6 Bray
- .7 Victaulic
- .8 Or approved equivalent.

.2 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.

.3 Provide valves of the same manufacturer where possible.

.4 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.

.5 Valid CRN (Canadian Registration Number) required for each valve.

.6 Materials:

.1	Bronze:	ASTM B62 or B61 as applicable
.2	Brass:	ASTM B283 C3770
.3	Ductile Iron:	ASTM A536 Grade 65-45-12
.4	Cast Iron:	ASTM A126 Class B

.7 End Connections:

.1	Threaded ends:	ANSI B1.20.1
.2	Flanged ends:	ANSI B16.1 (Class 125), ANSI B16.5
.3	Face-to-face dimensions:	ANSI B16.10

.8 Design and Testing:

.1	Bronze Gate & Check valves:	MSS-SP-80
.2	Ball Valves:	MSS-SP-110
.3	Cast Iron Gate Valves:	MSS-SP-70
.4	Cast Iron Globe Valves:	MSS-SP-85
.5	Cast Iron Check:	MSS-SP-71
.6	Butterfly Valves:	MSS-SP-67

2.2 HYDRONIC SYSTEMS TO 150 PSIG, ABOVE GROUND

.1	Nominal Operating Pressure	125 psig
.2	Design Pressure	150 psig
.3	Test Pressure	225 psig
.4	Design Temperature	350°F
.5	Corrosion Allowance	0.0625 in.
.6	Steel Pipe	ASTM A53 Gr.B ERW or ASTM A106 Gr.B SMLS, sch 40,
	Joints, 2" and smaller	screwed
	Screwed Fittings	150 Lb. malleable iron
	Unions	Cl.150, ASTM A-47 malleable iron, ASTM A-153 galvanized, ANSI B2.1 threads.
	Flanges	ASTM A105, Class 150, raised face, weld neck or slip on
	Bolts	ASTM A307 C.S. bolts, sq. head; ASTM A563 nuts, hex head
	Gaskets	1/16" (1.6 mm) thick preformed non-asbestos graphite fibre.
.7	Copper Tubing, 2" and Smaller	ASTM B88, Type L, hard drawn.
	Joints:	Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220°C to 280°C.
	Fittings:	ASME B16.18, cast brass, or ASME B16.22, solder wrought copper
	Dielectric Unions	Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
	Dielectric Waterway Fittings	Copper silicon casting conforming to UNS C87850 with grooved and/ or threaded ends. Victaulic Series 647.
.8	Valves, 2" and smaller	ASTM A105
	Gate Valves (Isolating)	300 psig non-shock WOG, ASTM B62 bronze body, solid wedge disc, rising stem, bronze trim, threaded ends, Kitz #25

	Globe Valves (Throttling)	300 psig non-shock WOG, ASTM B62 bronze body, composition (Teflon) disc, rising stem, bronze trim, threaded ends, Kitz #09
	Check Valves (Backflow)	300 psig non-shock WOG, ASTM B62 bronze body, Y-pattern horizontal, swing type disc, threaded ends, Kitz #29
	Ball Valves (Drain)	600 psig non-shock WOG, forged brass, 2-piece, chrome ball and stem, full port, blow-out proof PTFE seats & stem, lever handle, threaded ends, Kitz #68AC.

.9 Provide stem extensions for insulated piping.

.10 Provide gear operator and chain on valves installed above 10-ft AFF.

.11 Strainers, 2" and smaller — Class 250, 400 psig WOG, cast iron body, Y-pattern, screwed cap and ends, A167 304 stainless steel screen with 1/32" perforations. Mueller Steam 11M.

2.3 IN-FLOOR HYDRONIC RADIANT SYSTEMS TO 150 PSIG

.1 Tube Materials: Tube shall be cross-linked polyethylene (PEX) manufactured by PEX-a or peroxide method.

.1 Tubing Type: Wirsbo hePEX tubing.

.2 Oxygen Barrier: Tube shall have an oxygen barrier capable of limiting oxygen migration through the tube wall to no greater than 0.10 g/m3/day at 104-degree F (40 degrees C) water temperature per the requirements of DIN 4726.

.3 PEX tubing shall be CSA B137.5 listed for both hydronic and potable water distribution systems.

.4 PEX tubing shall be manufactured in accordance with ASTM F876 and ASTM F877. The tube shall be listed to ASTM by an independent third-party agency.

.5 PEX tubing shall be ASTM F876 tested and approved for excessive temperature and pressure for 725 hours at 210 degrees F (99 degrees C) at 150 psi (1035 kPa).

.6 PEX tubing shall have Standard Grade hydrostatic design and pressure ratings of 200 F (82 degrees C) at 80 psi (551 kPa), 180 degrees F (82 degrees C) at 100 psi (689 kPA), and 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa). Temperature and pressure ratings shall be issued by the Plastic Pipe Institute (PPI), a division of the Society of the Plastic Industry (SPI).

.7 Minimum bend radius for cold bending of the PEX tubing shall not be less than 6 times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by tube manufacturer.

.2 Fitting Materials: Fittings shall be manufactured of polysulfone or dezincification resistant brass. Fittings shall be nose cone insert type compression fitting, nose cone insert type swivel fitting or PEX-a cold expansion type fitting.

.1 Fittings shall be supplied by the PEX tubing manufacturer.

.2 Compression fitting shall be an assembly consisting of nose cone insert, compression ring and compression nut.

.3 Swivel fitting shall be an assembly consisting of nose cone insert, swivel nut and PEX-a cold expansion ring.

.4 PEX-a cold expansion type fitting shall be an assembly consisting of insert and PEX-a cold expansion ring.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

.1 Copper Tubing: ASTM B88, Type M and DWV, hard drawn.

.1 Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.

.2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 4428°F to 536°F (220°C to 280°C).

2.5 CIRCUIT BALANCING VALVES

.1 Circuit Balancing Valves; 2" (50 mm) and smaller

.1 Screwed connection, globe style design, nonferrous, pressure die-cast, nonporous DZR brass. A metal Copper Alloy. Valves shall be sized to flow and selected for 2 ft pressure drop across the valve in fully open position in accordance with manufacturer's recommendations.
.2 Valves shall provide the following functions:
  .1 Precise flow measurement.
  .2 Precision flow balancing.
  .3 Positive shut off with no drip seat and teflon disc.
  .4 Drain connection with protective cap.
.3 Valves shall have four 360° adjustment turns of handwheel for maximum vernier-type setting with "Hidden Memory" feature to program the valve with precision tamper-proof balancing setting.
.4 Valves shall be shipped in a 4.5 R factor polyurethane container that shall be used as insulation after valve is installed.
.5 Provide valves suitable for maximum working pressure of 250 psi (1720 kPa) and maximum operating temperature of 250°F (121°C).
.6 Acceptable Products:
  .1 S.A. Armstrong CBV
  .2 IMI Engineering STAD
  .3 Victaulic TA 787
  .4 Or approved equivalent

3 EXECUTION

3.1 PREPARATION

.1 Ream pipe and tube ends, remove burrs and bevel plain end ferrous pipe.
.2 Remove scale and dirt on inside and outside before assembly.
.3 Prepare piping connections to equipment with flanges or unions.
.4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
.5 After completion, fill, clean, and treat systems.

3.2 APPLICATIONS

.1 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
.2 Install unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
.3 Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
.4 Provide pipe hangers and supports to CSA B51 unless indicated otherwise.
.5 Use gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
.6 Use globe valves for throttling, bypass, manual flow control services, for balancing & in bypass around control valves.
.7 Use spring loaded check valves on discharge of condenser water pumps.
.8 Use wafer check valves where required to suit space and or weight limitations
.9 Use 3/4-inch (20 mm) gate or ball valves with cap and chain for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
.10 Use lug end butterfly valves to isolate equipment.
.11 Butterfly valves may be used as isolation and throttling duty for large pipe sizes 2-1/2" (65 mm) and above.
.12 Gasket material shall be Grade 'E' EPDM compound conforming of ASTM D2-2000 and suitable for an operating temperature range of -34ºC to 110ºC.
.13 Small runouts, size 3/4" (20 mm) and less for extension of domestic make-up piping may be constructed using hand drawn copper tube type 'K' or "L" and comply to ASTM B88.

3.3 INSTALLATION

.1 Install to manufacturer's instructions.

.2 Install heating water piping to CSA B51.
.3 Route piping in orderly manner, parallel to building structure, and maintain gradient.
.4 Install piping to conserve building space, and not interfere with use of space.
.5 Group piping whenever practical at common elevations.
.6 Sleeve pipe passing through partitions, walls and floors.
.7 Slope piping and arrange to drain at low points.
.8 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
.9 Inserts:
  .1 Provide inserts for placement in concrete formwork.
  .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4" (100 mm).
  .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
.10 Pipe Hangers and Supports:
  .1 Install to CSA B51.
  .2 Support horizontal piping as scheduled.
  .3 Install hangers to provide minimum 1/2" (13 mm) space between finished covering and adjacent work.
  .4 Place hangers within 12" (300 mm) of each horizontal elbow.
  .5 Use hangers with 1-1/2" (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  .6 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  .8 Provide copper plated hangers and supports for copper piping.
  .9 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
.11 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
.12 Provide access where valves and fittings are not exposed.
.13 Slope piping and arrange systems to drain at low points. Eccentric reducers shall be provided to keep the bottom of sloped piping aligned in order to minimize risk of water hammer and to facilitate drainage.
.14 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer (VOC content not to exceed 250 g/L) to welds.
.15 Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
.16 Valves shall be installed with stems upright or angled 45 deg. not inverted, above horizontal unless instructed otherwise.
.17 Air vents shall be selected to suit the system operating pressures and shall be automatic and complete with isolating valves.
.18 All strainers 1-1/2" (38mm) & larger shall be fitted with chain valves.
.19 Unless specified otherwise, drain piping shall be sloped down in the direction of flow not less than 1" in 40 feet.
.20 Pipe all discharge from temperature & pressure safety relief valves to a point of safe discharge directly into a floor drain, hub drain or safe outdoor location.
.21 Install wafer check valves at a minimum installation point of 8 pipe diameters downstream of pumps.
.22 Silent check valves are not to be used with reciprocating pumps.

3.4 EQUIPMENT CONNECTIONS

.1 Install unions or flanges at connections to all equipment and specialty components.
.2 Arrange piping connections to allow ease of access and removal of equipment.
.3 Align and independently support piping adjacent to equipment connections in order to prevent piping

stresses from being transferred to equipment.

.4 Piping reducers shall be used where equipment connections differ from pipe sizes indicated. The use of bushings will not be permitted.

.5 Install removable sections of pipe 12" (300 mm) spool pieces on the suction side of pumps and where needed for ease of maintenance.

3.5 VALVES, COCKS AND FAUCETS

.1 Use valves of line size unless noted otherwise.

.2 Provide isolating valves in each branch from the main line and where indicated.

.3 Provide isolating valves at all equipment connections.

.4 Provide globe valves or ball valves complete with memory stop at the discharge of each pump and where valves are used for regulating or throttling purposes.

.5 Provide 1/2" (13 mm) brass hose bibbs at all low points of each system, where the system cannot be drained through the main floor or return piping.

.6 Where new valves are installed to replace existing valves and it is impractical to shut-down and drain the entire system, valves shall be replaced using pipe freezing techniques.

3.6 HYDRONIC SPECIALTIES

.1 Refer to Section 23 21 16 – Hydronic Specialties

.2 Air Vents

.1 Provide 1" (25 mm) diameter air vent chamber at each riser feeding terminal units. Install chambers as high as possible within unit and provide manual air vent connected to air chamber by flexible tubing.

.2 Provide a float type automatic air vent at any high points of hot water supply and return piping not vented through a convector etc. and at high point of piping for each hot water coil. The discharge of air vent shall terminate over a floor drain in mechanical rooms or over a sink in service rooms. A shut-off valve shall be provided on each automatic air vent and an access door and frame shall be provided for air vents located above ceilings.

.3 Automatic Feed Valves: provide automatic feed valve on the cold-water make-up line to each new hot water heating system.

.4 Air Cushion Tanks

.1 Provide air cushion tanks of size noted where indicated.

.2 Provide housekeeping pad for floor mounting of tank.

.3 Terminate drainout line at nearest funnel floor drain, or service sink.

.4 Adjust charge to system static pressure at point of connection plus 5 psi (35 kPa).

.5 Air Eliminators: provide an air eliminator at each new air cushion (expansion) tank.

.6 Circuit Balancing Valve (CBV): provide a CBV in each branch serving a heating and/or cooling terminal unit and where indicated on drawings. Installation shall be in accordance with manufacturer's installation instructions. Ensure that manufacturer's recommended clearances are maintained to minimize turbulence and to promote accuracy.

.7 Supply and install threaded couplings or half coupling for flow switches that are supplied under Section 25

.8 Install flow switches as supplied under Section 25

3.7 CONTROLS DEVICES

.1 Install pipe wells for various remote sensors such as temperature, pressure and flow sensors. Supply of sensors and controls wiring will be under Section 25.

.2 Install control valves for fluid flow control. Supply of valves, valve actuators and controls wiring will be under Section 25.

3.8 TESTING AND INSPECTION

.1 Test liquid heat transfer piping hydrostatically at not less than 150% of operating pressure or not less than 125 psi (860 kPa) whichever is the greater. Test period shall be not less than six (6) hours duration during which time each joint shall be inspected, given a sharp tap with a hammer and checked for leaks.

.2 Arrange and pay for inspection by authorities having jurisdiction.

3.9 ADJUSTING AND BALANCING

.1 Instruments used for this work shall be accurately calibrated and maintained in good working order, and shall include:
- .1 one set of pressure gauges and fittings.
- .2 dry bulb thermometer.
- .3 wet bulb thermometer.
- .4 thermocouple unit and thermocouple.
- .5 set of balancing cock adjustment wrenches.
- .6 portable field flow meter.

.2 Prepare the liquid heat transfer systems as follows:
- .1 Install any additional devices required for effective balancing as advised by the Systems Verification Agency.
- .2 Open all valves and return line balancing cocks.
- .3 Remove and clean all strainers.
- .4 Check pump rotation.
- .5 Check expansion tanks to make sure they are not air bound and that the system is full of water.
- .6 Check all air vents at high points of water systems to make sure they are installed properly and are operating freely. Make certain all air is removed from circulating system.
- .7 Set all temperature controls so that all coils are calling for full cooling. This should close all automatic bypass valves at coil and chillers. To balance hot water coils, set systems to call for full heating.
- .8 Check operation of automatic bypass valve.
- .9 Check and set operating temperature of heat exchangers to design requirements.

.3 Balance the liquid heat transfer systems as follows:
- .1 Complete air balance must have been accomplished before water balance is begun.
- .2 Set chilled water, hot water and glycol pumps to proper gpm delivery.
- .3 Adjust flow of hot water through heat exchangers.
- .4 Check leaving water temperatures and return water temperatures, and pressure drop through heat exchangers. Reset to correct design temperatures.
- .5 Check water temperature at inlet side of cooling and heating coils. Note rise or drop of temperatures from source.
- .6 Balance each chilled water and hot water coil.
- .7 Upon completion of flow readings and coil adjustments, mark all settings and record all data.
- .8 After making adjustments to coils, recheck settings at pumps, and heat exchangers. Readjust if required.
- .9 Install pressure gauges on each coil, then read pressure drop through coil at set flow rate on call for full cooling and full heating. Set pressure drop across bypass valve to match coil full flow pressure drop. This prevents unbalanced flow conditions when coils are on full bypass.
- .10 Check and record the following items at each cooling and heating element:
  - .1 Inlet water and air temperature.
  - .2 Leaving water and air temperature.
  - .3 Pressure drop of each coil.
  - .4 Pump operating suction and discharge pressures and final t.d.h.
  - .5 Pressure drop across bypass valve.
  - .6 All mechanical specifications of pumps.
  - .7 Rated and actual running amperage of pump motor.

.4 After completion of adjusting and balancing and submittal of records notify the Systems Verification Agency and the Consultant and assist in verifications. If systems fail verification, readjust and balance systems to the satisfaction of the Consultant.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 21 16 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Expansion tanks
.2 Air vents.
.3 Air separators.
.4 Strainers.
.5 Pump suction fittings.
.6 Combination fittings.
.7 Relief valves.
.8 Glycol System

1.4 REFERENCES

.1 ASME - SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

1.5 SUBMITTALS

.1 Section 20 01 01: Procedures for submittals.
.2 Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.
.3 Submit inspection certificates for pressure vessels from TSSA.
.4 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
.5 Record actual locations of flow controls.
.6 Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Accept valves on site in shipping containers with labeling in place. Inspect for damage.
.2 Provide temporary protective coating on cast iron and steel valves.
.3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
.4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

2 PRODUCTS

2.1 DIAPHRAGM TYPE EXPANSION TANKS

.1 Manufacturers:
  .1 Amtrol
  .2 Bell & Gossett-Xylem
  .3 Armstrong
  .4 Taco

.5 Calefactio
.6 Or approved equivalent

.2 Construction: Welded steel, tested and stamped to ASME SEC 8-D; supplied with National Board Form U-1, rated for working pressure of 125 psi (860 kPa), with flexible butyl diaphragm sealed into tank and steel support stand.

.3 Accessories: Pressure gauge and air-charging fitting, tank drain, pre-charge to 11 psi (80 kPa).

.4 Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker and valved by-pass.

.1 Size: As scheduled.

2.2 AIR VENTS

.1 Manual Type: Short vertical sections of 2" (50 mm) diameter pipe to form air chamber, with 0.12” (3 mm) brass needle valve at top of chamber.

.2 Float Type:

.1 Manufacturers:

.1 Armstrong
.2 Amtrol
.3 Taco
.4 Bell & Gossett-Xylem
.5 Calefactio
.6 Or approved equivalent

.2 Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.3 AIR SEPARATORS

.1 Air Separators:

.1 Manufacturers:

.1 Amtrol
.2 Armstrong
.3 Bell & Gossett-Xylem
.4 Taco
.5 Calefactio
.6 Or approved equivalent

.2 Steel, tested and stamped to ASME SEC 8-D; for 125 psi (860 kPa) operating pressure, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.4 STRAINERS

.1 Refer to 20 05 00.

2.5 PUMP SUCTION FITTINGS

.1 Refer to Section 23 21 23 – Hydronic Pumps

2.6 COMBINATION PUMP DISCHARGE (TRIPLE DUTY) VALVES

.1 Refer to Section 23 21 23 – Hydronic Pumps

2.7 RELIEF VALVES

.1 Manufacturers:

.1 Sarco.
.2 Watts
.3 Bell & Gossett-Xylem
.4 Conbraco

.5 Or approved equivalent

.2 Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled

2.8 GLYCOL SYSTEM

.1 Packaged hydronic glycol system feeder system with 17 gallon (64 litre) storage/mixing tank, cover, suction hose, inlet strainer, pressure pump with thermal cut-out, pressure switch, check valve, cord and plug, pre-charged accumulator tank with EPDM diaphragm, manual diverter valve, pressure regulating valve 5 to 55 psig (35- 380 KPa), complete with pressure gauge, strainer, check valve, union, ½" x 36" (12 mm x 900 mm) long flexible connection hose, low level alarm panel, remote monitoring contacts, audible alarm and low level pump cut-out. Pressure pump shall be capable of running dry without damage. Power supply 120/1/60 (50 W). Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.

.2 Options: Low level Alarm Panel c/w Remote Monitoring Dry Contacts and Selectable Audible Alarm

.3 Manufacturers:

.1 Axiom

.2 Bell & Gossett-Xylem

.3 Armstrong

.4 Neptune

.5 Calefactio

.6 Or approved equivalent

.4 Glycol Solution:

.1 40% inhibited propylene glycol and 60% water solution mixed, suitable for operating temperatures from -6°F to 210°F (-21°C to 100°C).

3 EXECUTION

3.1 INSTALLATION

.1 Install specialties to manufacturer's instructions.

.2 Where large air quantities can accumulate, provide enlarged air collection standpipes.

.3 Provide manual air vents at system high points and as indicated.

.4 For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain for water systems and to holding tank for glycol/water systems.

.5 Provide air separator on suction side of system circulation pump and connect to expansion tank.

.6 Provide valved drain and hose connection on strainer blowdown connection.

.7 Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

.8 Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.

.9 Support pump fittings with floor mounted pipe and flange supports.

.10 Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

.11 Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

.12 Pipe relief valve outlet to nearest floor drain for water systems and to holding tank for glycol/water systems.

.13 Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

.14 Clean and flush glycol system before adding glycol solution.

.15 Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Set to fill at 12psi (80 kPa).

.16 Perform tests determining strength of glycol and water solution and submit written test results.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 21 23 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Circulators
.2 Vertical in-line pumps.
.3 Suction guides
.4 Combination pump discharge (triple duty) valves

1.4 REFERENCES

.1 UL 778 Motor Operated Water Pumps
.2 ASHRAE Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
.3 CSA B214 Installation Code for Hydronic Heating Systems

1.5 PERFORMANCE REQUIREMENTS

.1 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 SUBMITTALS

.1 Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
.2 Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
.3 Millwright's Certificate: Certify that base mounted pumps have been aligned.
.4 Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum ten years' experience.
.2 Alignment: Align base mounted pumps by qualified millwright.

1.8 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

1.9 EXTRA MATERIALS

.1 Provide one set of mechanical seals for each pump.
.2 Provide 2 sets of cartridges for each side-stream filter.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Acceptable manufacturers:
  .1 Armstrong
  .2 Bell & Gossett-Xylem
  .3 Taco
  .4 Patterson
  .5 Grundfos
  .6 Or approved equivalent
.2 Information including but not limited to pump efficiency and power are based on basis of design selection. Alternate product vendors shall provide pump that is selected for most efficient operation.

2.2 IN-LINE CIRCULATORS

.1 Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125psi (860 kPa) maximum working pressure.
.2 Casing: Cast iron, with flanged pump connections.
.3 Impeller: Cadmium plated steel, keyed to shaft.
.4 Bearings: Two oil lubricated bronze sleeves.
.5 Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.
.6 Seal: Carbon rotating against a stationary ceramic seat, 225°F (107°C) maximum continuous operating temperature.
.7 Seal: Carbon rotating against a stationary ceramic seat, viton fitted 275°F (135°C) maximum continuous operating temperature.
.8 Drive: Flexible coupling.
.9 Performance: as scheduled
.10 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

2.3 SUCTION GUIDE

.1 Manufacturers:
  .1 Armstrong.
  .2 Bell & Gossett-Xylem
  .3 Taco
  .4 Patterson
  .5 Victaulic
  .6 Or approved equivalent
.2 Furnish and install on the suction of each pump a suction guide, with outlet flow stabilizing guide vanes, removable stainless-steel strainer and fine mesh start-up strainer.
.3 Supply fitting with cast iron body with ANSI 125 flanged ports.
.4 The mechanical contractor shall inspect the strainer prior to activating the pump and further, shall remove the fine mesh start-up strainer after a short running period (24 hours maximum).
.5 Space shall be provided for removal of the strainer and connection of the blow down valve.
.6 The inlet size shall match the pipe size as shown on mechanical drawings piping schematic.
.7 The outlet size shall match the pump’s flange connection.

2.8 COMBINATION PUMP DISCHARGE (TRIPLE DUTY) VALVES

.1 Manufacturers:
  .1 Armstrong.
  .2 Bell & Gossett-Xylem
  .3 Taco
  .4 Patterson
  .5 Victaulic
  .6 or approved equivalent
.2 Furnish and install on the discharge side of each pump a triple duty combination valve.
.3 Each valve shall incorporate the following three functions in one body:
  .1 Tight shut-off
  .2 Spring-closure type silent non-slam check.

.3 Effective throttling

.4 The body shall have two (2) ¼" NPT connections on each side of the valve seat. Two connections shall have brass pressure and temperature metering ports, with EPDM check valves and gasketed caps. Two other connections to be supplied with drain plugs.

.5 Metering ports are to be interchangeable with drain ports to allow for measurement flexibility when installed in tight locations.

.6 The valve disc shall be bronze plug and disc type with EPDM seat to ensure tight shut-off and silent check operation.

.7 The valve stem shall be stainless steel with flat surfaces provided for adjustment with open-ended wrench.

.8 For Grooved Piping: Valve body shall be ductile iron with grooved ends and factory installed anti-rotation lugs on the inlet and outlet of the body.

.9 Flange rating, where necessary shall be ANSI-125 or ANSI-250 ductile iron flanges with anti-rotation lugs and EPT gaskets.

.10 For Welded Flange Piping: Valve body shall be cast iron with non flanged port to 6" (cast iron ANSI-125 or ductile iron ANSI-250 for 8" to 12").

.11 The valve shall be selected and installed in accordance with the manufacturer's instructions and be suitable for the pressure and temperature specified.

.12 The valve shall be selected to handle the maximum pump design flow with maximum pressure drop of 3 psi (20.7 kPa). Do not select the valve based on pump flange or pipe connections.

.13 Contractor shall provide pipe transition for valve connection as is required.

3 EXECUTION

3.1 PREPARATION

.1 Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

.1 Install to manufacturer's instructions and as indicated by flow arrows.

.2 Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4" (102 mm) and over.

.3 Provide access space around pumps for service. Provide no less than minimum recommended by manufacturer.

.4 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.

.5 Decrease from line size with long radius reducing elbows or reducers.

.6 Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

.7 Provide air cock and drain connection on horizontal pump casings.

.8 Provide drains for bases and seals, piped to and discharging into floor drains.

.9 Check rotation, align, and certify alignment of base mounted pumps prior to start-up.

.10 Lubricate pumps before start-up.

.11 Provide side-stream filtration system for heating water systems. Install across pump with flow from pump discharge to pump suction from pump tappings.

3.3 START-UP

.1 Before starting pump, check that cooling water system, over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
.7 Eliminate air from scroll casing.
.8 Adjust water flow rate through water-cooled bearings.
.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
.10 Adjust alignment of piping and conduit to ensure true flexibility at all times.
.11 Eliminate cavitation, flashing and air entrainment.
.12 Adjust pump shaft seals, stuffing boxes, glands.
.13 Measure pressure drop across strainer when clean and with flow rates as finally set.
.14 Replace seals if pump used to degrease system or if pump used for temporary heat.
.15 Verify lubricating oil levels.

3.4 PERFORMANCE VERIFICATION

.1 General
  .1 In accordance with manufacturer's recommendations.
.2 Exclusions:
  .1 This paragraph does not apply to small in-line circulators.
.3 Assumptions: These PV procedures assume that:
  .1 Manufacturer's performance curves are accurate.
  .2 Valves on pump suction and discharge provide tight shut-off.
.4 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 23 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Piping.
.2 Refrigerant.
.3 Moisture and liquid indicators.
.4 Valves.
.5 Strainers.
.6 Check valves.
.7 Pressure relief valves.
.8 Filter-driers.
.9 Solenoid valves.
.10 Expansion valves.
.11 Receivers.
.12 Flexible connections.

1.4 REFERENCES

.1 The Air Conditioning, Heating and Refrigeration Institute
- .1 AHRI 495 - Refrigerant Liquid Receivers.
- .2 AHRI 710 - Liquid-Line Driers.
- .3 AHRI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers
- .4 AHRI 750 - Thermostatic Refrigerant Expansion Valves.
- .5 AHRI 760 - Solenoid Valves for Use With Volatile Refrigerants.

.2 American Society of Heating Refrigeration Air Conditioning Engineers
- .1 ASHRAE 15 - Safety Standard for Refrigeration Systems.
- .2 ASHRAE 34 - Designation and Safety Classification of Refrigerants.

.3 The American Society of Mechanical Engineers
- .1 ASME - SEC 9 - Welding and Brazing Qualifications.
- .2 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.
- .4 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- .5 ASME B31.9 - Building Services Piping.
- .6 ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

.4 American Society for Testing and Materials
- .1 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .2 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .3 ASTM B88 - Seamless Copper Water Tube.
- .4 ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .5 ASTM F708 - Design and Installation of Rigid Pipe Hangers.

.5 American Welding Society
- .1 AWS A5.8 - Filler Metals for Brazing and Braze Welding.
- .2 AWS D1.1 - Structural Welding Code - Steel.

.6 ANSI/MSS

.1 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
.2 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
.3 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

.7 UL 429 - Electrically Operated Valves.

1.5 SUBMITTALS

.1 Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
.2 Product Data: Provide general assembly of specialties, including manufacturer’s catalogue information. Provide manufacturers catalogue data including load capacity.
.3 Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
.4 Test Reports: Indicate results of leak test, acid test.
.5 Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
.6 Submit welder’s certification of compliance with ASME SEC 9.
.7 Prepare and submit all records and notices required by authorities having jurisdiction.
.8 Record exact locations of equipment and refrigeration accessories on record drawings.

1.6 QUALIFICATIONS

.1 Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.
.2 Design piping system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the Project is located.
.3 Persons servicing, testing and/or performing tasks associated with the removal, relocation and/or refilling of refrigeration piping and/or equipment that contains ozone depleting substances and other halocarbons shall be certified under Section 34 of O. Reg. 463/10.

1.7 REGULATORY REQUIREMENTS

.1 Conform to CSA B52 Mechanical Refrigeration Code as adopted.
.2 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.
.3 Welders Certification: To ASME SEC 9.
.4 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Transport, handle, store, and protect products.
.2 Deliver and store piping and specialties in shipping containers with labeling in place.
.3 Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
.4 Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

1.9 MAINTENANCE MATERIALS

.1 Provide two refrigeration oil test kits each containing everything required to conduct one test.
.2 Provide two filter-dryer cartridges of each type.

2 PRODUCTS

2.1 PIPING

.1 Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.

.1 Fittings: ASME B16.22 wrought copper.
.2 Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1185 to 1480ºF (640 to 805º C.)

.2 Copper Tubing to 22 mm OD: ASTM B88, Type K, annealed.
.1 Fittings: ASME B16.26 cast copper.
.2 Joints: Flared.

.3 Pipe Supports and Anchors:
.1 Conform to ASME B31.5.
.2 Hangers for Pipe Sizes ½" to 1-1/2" (13 to 38 mm): Malleable iron adjustable swivel, split ring.
.3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
.5 Wall Support for Pipe Sizes to 3" (75 mm): Cast iron hook.
.6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
.7 Vertical Support: Steel riser clamp.
.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
.10 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
.11 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.2 MOISTURE AND LIQUID INDICATORS

.1 Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, colour coded paper moisture indicator with removable element cartridge and plastic cap; for maximum working pressure of 500psi (3450 kPa), and maximum temperature of 200ºF (93ºC).

2.3 VALVES

.1 Ball Valves:
.1 Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 300ºF (149ºC).

.2 Service Valves:
.1 Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi (3450 kPa).

2.4 STRAINERS

.1 Straight Line or Angle Line Type:
.1 Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless-steel wire or monel reinforced with brass; for maximum working pressure of 430 psi (2960 kPa.)

.2 Straight Line, Non-Cleanable Type:
.1 Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure to suit application.

2.5 CHECK VALVES

.1 Globe Type:
.1 Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless-steel spring, teflon seat disc; for maximum working pressure of 430 psi (2930 kPa) and maximum temperature of 300ºF (149ºC).

.2 Straight Through Type:
.1 Brass body and disc, phosphor-bronze or stainless-steel spring, neoprene seat; for maximum working pressure of 430 psi (3450 kPa) and maximum temperature of 200ºF (93ºC).

2.6 PRESSURE REGULATORS

.1 Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi (0 to 550 kPa) range, for maximum working pressure of 450 psi (3100 kPa).

2.7 PRESSURE RELIEF VALVES

.1 Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 235 psi (1620 kPa) setting; selected to ASHRAE 15.

2.8 FILTER-DRIERS

.1 Replaceable Cartridge Angle Type:
  .1 Shell: AHRI 710, UL listed, brass, removable cap, for maximum working pressure of 350 psi (2410 kPa).
  .2 Filter Cartridge: Pleated media with integral end rings, stainless steel support.
  .3 Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumina.
  .4 Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.

.2 Permanent Straight Through Type:
  .1 AHRI 710, UL listed, steel shell with moulded desiccant filter core, for maximum working pressure of 350 psi (2410 kPa).

2.9 SOLENOID VALVES

.1 Valve: AHRI 760, pilot operated, copper or brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi (3450 kPa). Stem to permit manual operation in case of coil failure.

.2 Coil Assembly: UL 429, UL listed, replaceable with moulded electromagnetic coil, moisture and fungus proof, with surge protector and colour coded lead wires, integral junction box with pilot light.

.3 Electrical Characteristics: 120 volts, single phase, 60 Hz.

2.10 EXPANSION VALVES

.1 Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.

.2 Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 6 degrees C superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.11 RECEIVERS

.1 Internal Diameter 6” (150 mm) and Smaller:
  .1 AHRI 495, UL listed, steel, brazed; 2760 kPa maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.

.2 Internal Diameter Over 6” (150 mm):
  .1 AHRI 495, welded steel, tested and stamped to ASME SEC 8D; 2760 kPa with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.12 FLEXIBLE CONNECTORS

.1 Corrugated stainless steel hose with single layer of stainless-steel exterior braiding, minimum 9” (230 mm) long with copper tube ends; for maximum working pressure 500 psi (3450 kPa).

3 EXECUTION

3.1 SYSTEM DESCRIPTION

.1 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing is consistently provided.
.2 Provide pipe hangers and supports to ASTM B31.5 unless indicated otherwise.
.3 Liquid Indicators:
  .1 Use line size liquid indicators in main liquid line leaving condenser.
  .2 If receiver is provided, install in liquid line leaving receiver.
  .3 Use line size on leaving side of liquid solenoid valves.
.4 Valves
  .1 Use service valves on suction and discharge of compressors.
  .2 Use gauge taps at compressor inlet and outlet.
  .3 Use gauge taps at hot gas bypass regulators, inlet and outlet.
  .4 Use check valves on compressor discharge.
  .5 Use check valves on condenser liquid lines on multiple condenser systems.
.5 Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
.6 Strainers:
  .1 Use line size strainer upstream of each automatic valve.
  .2 Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
  .3 On steel piping systems, use strainer in suction line.
  .4 Use shut-off valve on each side of strainer.
.7 Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
.8 Permanent Filter-Driers:
  .1 Use in low temperature systems.
  .2 Use in systems utilizing hermetic compressors.
  .3 Use filter-driers for each solenoid valve.
.9 Replaceable Cartridge Filter-Driers:
  .1 Use vertically in liquid line adjacent to receivers.
  .2 Use filter-driers for each solenoid valve.
.10 Solenoid Valves:
  .1 Use in liquid line of systems operating with single pump-out or pump-down compressor control.
  .2 Use in liquid line of single or multiple evaporator systems.
  .3 Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
.11 Receivers:
  .1 Use on systems 18 kW and larger, sized to accommodate pump down charge.
  .2 Use on systems with long piping runs.
.12 Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

3.2 PREPARATION

.1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
.2 Remove scale and dirt on inside and outside before assembly.
.3 Prepare piping connections to equipment with flanges or unions.

3.3 REFRIGERANT RECOVERY / RECYCLING

.1 Removal, relocation and/or refilling of refrigeration piping and/or equipment that contains ozone depleting substances and other halocarbons including:
  .1 Solvents and sterilants
  .2 Fire extinguishing equipment
  .3 Refrigerants shall conform to regulations under the Environmental Protection Act, including O. Reg. 463 /10.
.2 Ozone depleting substances (ODS) and other halocarbons shall be recovered using equipment and

processes that are designed and approved specifically for the task.

.3 Disposal of ODS and other halocarbons and associated equipment and containers shall comply with requirements under the Environmental Protection Act, including O. Reg. 463 /10.

3.4 INSTALLATION

.1 Install refrigeration specialties to manufacturer's instructions.
.2 Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
.3 Install piping to conserve building space and not interfere with use of space.
.4 Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
.5 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
.6 Inserts:
  .1 Provide inserts for placement in concrete formwork.
  .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4” (100 mm.)
  .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
.7 Pipe Hangers and Supports:
  .1 Install to ASTM B31.5.
  .2 Support horizontal piping as scheduled.
  .3 Install hangers to provide minimum ½” (13 mm) space between finished covering and adjacent work.
  .4 Place hangers within 12” (300 mm) of each horizontal elbow.
  .5 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  .7 Provide copper plated hangers and supports for copper piping.
.8 Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
.9 Provide clearance for installation of insulation and access to valves and fittings.
.10 Provide access to concealed valves and fittings.
.11 Flood piping system with nitrogen when brazing.
.12 Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer (VOC content not to exceed 250 g/L) to welding.
.13 Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting.
.14 Insulate piping and equipment; refer to Section 20 07 16/20 07 19.
.15 Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
.16 Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
.17 Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
.18 Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
.19 Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
.20 Fully charge completed system with refrigerant after testing.
.21 Provide electrical connection to solenoid valves.

3.5 FIELD QUALITY CONTROL

.1 Test refrigeration system to ASME B31.5.
.2 Pressure test system with dry nitrogen to 210 psi (1470 kPa.) Perform final tests at 13 psi (92 kPa) vacuum and 210 psi (1470 kPa) using halide torch. Test to no leakage.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 31 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 REFERENCES

.1 ASHRAE HANDBOOK, HVAC SYSTEMS & EQUIPMENT
- .1 Duct Construction Recommendations

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .1 HVAC Duct Construction Standards - Metal and Flexible
- .2 HVAC Duct Systems Design
- .3 Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
- .4 Accepted Industry Practice for Industrial Duct Design
- .5 HVAC Systems - Testing, Adjusting and Balancing
- .6 Round Industrial Duct Construction Standards
- .7 Rectangular Industrial Duct Construction Standards
- .8 HVAC Air Duct Leakage Test Manual.
- .9 Guide for Steel Stack Construction

.3 National Fire Protection Association (NFPA)
- .1 80 Standard for Fire Doors and Windows
- .2 90A Standard for Installation of AC and Ventilation Systems
- .3 90B Standard for Installation of Warm Air Heating and AC Systems
- .4 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 255 Building Materials, Test of Burning Characteristics (same as ASTM E84)

.4 American Society for Testing and Materials (ASTM)
- .1 A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- .2 A167- Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .3 A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .4 A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 A1011/A1011M -Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.
- .6 B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .7 A240- Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
- .8 A480 - Standard Specification for General Requirements for Flat Rolled Stainless Heat-Resisting Steel Plate, Sheet and Strip
- .9 A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot Dip Process
- .10 E84- Standard Test Method for Surface Burning Characteristics of Building Materials
- .11 E477- Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Material and Prefabricated Silencers
- .12 E814- Standard Test Method for Fire Tests of Through Penetration Fire Stops

.5 American Welding Society (AWS)
- .1 B2.2 Brazing Procedures and Performance Qualifications
- .2 D9.1 Sheet Metal Welding Code

.6 Underwriter's Laboratories (UL)

.1	181	Factory Made Air Ducts and Air Connectors
.2	555	Standard for Safety Fire Dampers
.3	555S	Leakage Rated Dampers for Use in Smoke Control Systems
.4	723	Test for Surface Burning Characteristics of Burning Materials (ASTM E84)

1.4 PERFORMANCE REQUIREMENTS

.1 No variation of duct configuration or sizes permitted except by written permission.
.2 Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.
.3 Sizes indicated on drawings are clear inside dimensions and do not include for duct linings.

1.5 SUBMITTALS

.1 Division 20 01 01: Procedures for submittals.
.2 Product Data: Provide data for duct materials.
.3 Shop Drawings:
  .1 Factory fabricated ducts, fittings and joining systems.
  .2 Duct fitting particulars such as gauges, sizes, welds, reinforcements and configuration for 4" wg. (1000 kPa) pressure class and higher systems.
.4 Submit changes or alterations in ductwork layout, with supporting calculations showing that the modified design will not increase total pressure, before work commences. Submittals for proposed changes shall be stamped for acceptance prior to commencement of work.
.5 Test Reports: Indicate pressure tests performed. Include date; section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.
.6 Material Safety Data Sheets (MSDS) for sealants, adhesives and coatings.

1.6 PROJECT RECORD DOCUMENTS

.1 Division 20 01 01: Submittals for project closeout.
.2 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.7 QUALITY ASSURANCE

.1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.2 Perform Duct Leakage Testing to SMACNA "HVAC Air Duct Leakage Testing Manual"
.3 Maintain one copy of document on site.
.4 Asbestos Free: Insulating and sealing materials must be certified to be free of asbestos.
.5 Brazing: Certify brazing procedures, brazers, and operators in accordance with AWS B2.2 Brazing Procedures and Performance Qualifications
.6 Welding: Certify welding procedures, welding equipment and welders in accordance with AWS D9.1 Sheet Metal Welding Code.

1.8 REGULATORY REQUIREMENTS

.1 Ontario Building Code (OBC)
.2 Ontario Fire Code (OFC)
.3 Construct ductwork to NFPA 90A standards.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
.2 Maintain temperatures during and after installation of duct sealants.

2 PRODUCTS

2.1 MATERIALS

.1 Table of Materials

APPLICATIONS	MATERIALS
Rigid HVAC ducts, casings and fittings	ASTM A653 galvanized steel sheet, lock form quality, G90 zinc coating (0.90 oz/ft2) to ASTM A90. Sheets free of pits, blisters, slivers, and ungalvanized spots.
Aluminum Ducts, dryer vents	ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

.2 Hanger Rod: continuously threaded, ASTM A36 galvanized steel in general, stainless steel for stainless steel ducts.

.3 Sealant: Non-hardening, water resistant, fire resistive, low VOC (VOC content not to exceed 250 g/L), compatible with mating materials; liquid used alone or with tape, or heavy mastic.

.4 Supports: Angle iron, channels, rods and related supporting materials shall be galvanized or red oxide coated.

.5 Fasteners: Use galvanized rivets, screws and bolts throughout, except on stainless steel ductwork, use SS fasteners.

.6 Reinforcements: Provide galvanized steel or stainless-steel reinforcement shapes and plates to match ductwork.

.7 Tie Rods: Use galvanized steel, 1/4 inch minimum diameter fasteners for ductwork 36 inch or less in length; use 3/8 inch minimum diameter for lengths longer than 36 in.

2.2 DUCT CONSTRUCTION

.1 Duct Construction Schedule

Duct Application	Duct Pressure	Pressure Class (in.wg.)	Seal Class	Leakage Class
Rectangular HVAC Supply from AHU to terminal unit or reheat coil	Positive	4	A	6
Round HVAC Supply from AHU to terminal unit or reheat coil	Positive	4	A	3
Rectangular HVAC Supply from terminal unit or reheat coil to HEPA filter in OR air outlet	Positive	4	A	6
Rectangular HVAC Supply from terminal unit or reheat coil to air outlet	Positive	2	A	6
Round HVAC Supply from terminal unit or reheat coil to air outlet	Positive	2	A	3
Rectangular HVAC Single zone supply from AC Unit to air outlet	Positive	2	A	6
Round HVAC Single zone supply from AC Unit to air outlet	Positive	2	A	3
Rectangular HVAC Return from air outlet to AHU	Negative	2	A	6
Round HVAC Return from air outlet to AHU	Negative	2	A	3
Rectangular Sanitary exhaust ductwork	Negative	2	A	6
Round Sanitary exhaust ductwork	Negative	2	A	3
Rectangular General HVAC exhaust ductwork	Negative	2	A	6

Round General HVAC exhaust ductwork	Negative	2	A	3
Exhaust fan discharge ductwork	Positive	2	A	0

Notes:

1. Pressure class shall be the lower of exhaust fan shut-off pressure or value shown

2.3 DUCT SEALING

.1 Duct Sealing Requirements

SEAL CLASS	SEALING REQUIREMENTS
A	All transverse joints, longitudinal seams and duct wall penetrations
B	All transverse joints and longitudinal seams a
C	All transverse joints

2.4 DUCT LEAKAGE

.1 Leakage Class is defined as
$CL = F / (P)^{0.65}$
where: CL = Leakage Class
F = Leakage Factor (cfm/100-ft2 of duct surface)
P = Static pressure in the duct (in.wg.)

.2 Table

LEAKAGE FACTOR (F) CFM/100 –sq.ft. of DUCT SURFACE					
LEAK CLASS	**PRESSURE CLASS (in.wg.) (+ve or –ve)**				
C_L	**1**	**2**	**4**	**6**	**10**
48	48	75	118	154	214
24	24	38	59	77	107
12	12	19	30	38	54
6	6	9	15	19	27
3	3	5	7	10	13
0	0	0	0	0	0

2.5 DUCTWORK FABRICATION

.1 All Ductwork shall be constructed to withstand 1-1/2 times fan pressure at shut-off and 2" (500 Pa) minimum.

.2 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated in accordance with recommendations of ASHRAE and SMACNA.

.3 Joints and reinforcements:

.1 To SMACNA and ASHRAE

.2 May be made with the Ductmate System or Nexus System. System components shall be made of standard catalogue manufacture as supplied by Ductmate Industries, Inc. or Nexus Inc.

.4 Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.

.5 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

.6 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 4” (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.

.7 Provide standard 45-degree lateral wye takeoffs. Alternative 90-degree conical tee connections may be used only where specifically indicated.

2.6 ROUND SPIRAL LOCK SEAM DUCTWORK

.1 Spiral ducts shall be used where exposed round duct is shown, except in Mechanical Rooms.

.2 Spiral ducts and elbows shall not be used for watertight exhaust systems.

.3 Ducts and fittings shall be manufactured from minimum G90 galvanized steel meeting ASTM A527/A527M-85.

.4 Ductwork shall be "Uni-Seal" single wall, round spiral lock-seam type duct in wall thicknesses listed below.

.5 Fittings shall be "Uni-Seal" single wall, round fittings suitable for use with "Uni-Seal" ductwork in wall thicknesses as follows:

ROUND SPIRAL LOCK SEAM DUCTWORK - IP			
Diameter		**Minimum Steel Gauge**	
From	**To**	**Spiral Lock**	**Fittings**
3”	14”	26	22
15”	26”	24	20
27”	36”	22	20
37”	50”	20	18
51”	60”	18	18

ROUND SPIRAL LOCK SEAM DUCTWORK - SI			
Diameter		**Minimum Steel Gauge**	
From	**To**	**Spiral Lock**	**Fittings**
75	356	0.56	0.70
380	660	0.71	0.86
686	914	0.86	1.01
939	1270	1.01	1.32
1321	1524	1.32	1.62

.6 Acceptable Manufacturer: "Uni-Seal" spiral lock-seam duct and "Uni-Seal" fittings as manufactured by McGIll. Other manufacturers refer to Section 20 01 01

2.7 FLEXIBLE DUCTWORK

.1 Flexible ducts shall be factory fabricated to CAN/ULC S110, factory fabricated assembly with a laminated inner liner of aluminum foil, fiberglass and polyester, a galvanized steel helix coil formed to the inner liner, a fiberglass insulation blanket, and a polyethylene outer jacket. Flexible duct shall have

a flame-resistant rating of 25 or less and a smoke developed rating of 50 or less

FLEXIBLE DUCTWORK - IP		
Pressure rating	**Low & Medium Pressure**	**High Pressure**
Maximum positive pressure	6" wg	12" wg
Maximum negative pressure	4"wg	5" wg
Maximum velocity	4000 fpm	5500 fpm
Permeance	0.1 perm	0.1 perm
Operating temperature	-20°F to 250°F	-20°F to 250°F
Maximum thermal conductance	0.23 BTU/Hr-F°	0.23 BTU/Hr-F°
Listed & Labelled	Class 0, Class 1	Class 0, Class 1
Flexmaster type	5	3

FLEXIBLE DUCTWORK - SI		
Pressure rating	**Low & Medium Pressure**	**High Pressure**
Maximum positive pressure	3 kPa	6 kPa
Maximum negative pressure	2kPa	2.5 kPa
Maximum velocity	20 m/s	28 m/s
Permeance	0.1 perm	0.1 perm
Operating temperature	-20°F to 250°F	-28.9°C to 121.1°C
Maximum thermal conductance	0.23 BTU/Hr-F°	
Listed & Labelled	Class 0, Class 1	Class 0, Class 1
Flexmaster type	5	3

.2 Accessories: conical spin-in collars with butterfly volume dampers for connections to ductwork, round rigid galvanized steel fittings fabricated to SMACNA Standards and ASHRAE recommendations, bridge and gear clamps.

.3 Acceptable Manufacturers:

.1 Flexmaster

3 EXECUTION

3.1 INSTALLATION

.1 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.2 Install ductwork parallel to building lines.

.3 Support all ductwork from structural members. Where structural bearings do not exist, suspend strapping or hangers from steel channels or angles. Provide supplementary structural members. Do not suspend from metal deck.

.4 Do not break continuity of insulation vapour barrier by hangers or rods.

.5 Hangers shall be steel angles with supporting rods, locking nuts and washers to following table:

DUCT HANGERS - IP			
Duct Sizes (Largest side)	**Angle Size**	**Rod Size**	**Spacing**

Up to 30"	1" x 1" x 1/8"	1/4" diameter	10 ft
31" to 42"	1-1/2" x 1-1/2" x 1/8"	1/4" diameter	10 ft
43" to 60"	1-1/2" x 1-1/2" x 1/8"	3/8" diameter	10 ft
61" to 84"	2" x 2" 1/8"	3/8" diameter	8 ft

DUCT HANGERS - SI			
Duct Sizes (Largest side)	**Angle Size**	**Rod Size**	**Spacing**
Up to 30"	25 x 25 x 3 mm	6mm diameter	3 m
31" to 42"	40 x 40 x 3 mm	6mm diameter	3 m
43" to 60"	40 x 40 x 3 mm	10mm diameter	3 m
61" to 84"	50 x 50 x 3 mm	10mm diameter	2.5 m

.6 Anchor all risers at bottom and support from building structure at each floor level.

.7 Vertical ducts passing through floors shall be supported on angles secured to duct bearing on the floor.

.8 Where ducts pass through walls, floors, openings required to have a fire resistance rating the opening in the construction around the duct shall be filled with an approved fire stop material as per NFPA 90A and fire damper shall also be installed with access doors as per the code.

.9 Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

.10 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.11 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.12 Use crimp joints with or without bead for joining round duct sizes 8" (200 mm) and smaller with crimp in direction of air flow.

.13 Use double nuts and lock washers on threaded rod supports.

.14 Connect terminal units to supply ducts directly or with 12" (300 mm) maximum length of flexible duct. Do not use flexible duct to change direction.

.15 Connect diffusers or light troffer boots to low pressure ducts directly or with 60" (1.5 m) maximum length of flexible duct held in place with strap or clamp.

.16 Connect flexible ducts to metal ducts with adhesive and metal or nylon straps.

.17 Ground across flexible connector with No. 2/0 braided copper strap.

.18 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.

.19 Balancing dampers shall be installed on branches as per locations shown on the drawings and as per the requirements of NEBB and AABC listing/measuring standards.

.20 Perform duct leakage testing for all ductwork installed under this contract.

.21 Paint all visible internal portions of duct outlets to grilles dull black. Internal painting of ductwork behind grilles shall be by Sheet Metal Contractor.

.22 Seams and penetrations in ductwork and plena shall be sealed in accordance with seal classifications as described in SMACNA and ASHRAE.

.23 Do not begin air balance until system has been completed and is in full working order. Put all heating, ventilating, and air conditioning system and equipment into full operation and continue the operation of same during each working day of balancing procedures. Provide assistance to the Testing and balancing Agency as required.

3.2 FLEXIBLE DUCTWORK

.1 Flexible ductwork may be installed for final connections to air outlets provided that not more than 5 ft. (1.5 mm) in length is used for each connection and where specifically indicated on drawings.
.2 All fittings used with flexible ductwork shall be rigid round duct.
.3 Use pre-insulated flexible ductwork where application is to be insulated.

3.3 DUCT CLEANLINESS

.1 All ductwork shall be handled and installed in accordance with the advanced level described in SMACNA Duct Cleanliness for New Construction Guidelines.
.2 Ductwork leaving the premises of the manufacturer may include some or all of the following:
  .1 Self-adhesive labels or marking for part(s) identification shall be applied to external surfaces only
  .2 Exposed mastic sealant
  .3 Light zinc oxide coating on the metal surface
  .4 A light coating of oil on machine formed ductwork
  .5 Minor protrusions into the airway of rivets, screws, bolts and other jointing devices
  .6 Internal insulation and associated fasteners
  .7 Discoloration marks from plasma cutting process.
  .8 To maintain cleanliness during transportation, all ductwork shall be sealed either by blanking or capping duct ends, bagging small fittings, surface wrapping or shrink wrapping. Care must be taken to prevent damage during transportation and offloading.
.3 A clean and dry environment where the ductwork is protected from dust must be provided for the storage of ductwork prior to installation. All sealed ends shall be visually examined and if damaged resealed with an appropriate material.
.4 During installation, the working area shall be clean, dry and the ductwork protected from dust.
.5 The internal surfaces of the uninsulated ductwork shall be wiped to remove excess dust immediately prior to installation.
.6 Open ends on completed ductwork and overnight work-in-progress shall be sealed.
.7 Access covers shall be firmly fitted in position on completion of each section of the work.
.8 Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.4 HVAC SYSTEM CLEANING

.1 Qualifications of HVAC Systems Cleaning Contractor
  .1 Member of National Air Duct Cleaners Association (NADCA)
  .2 Supervisor: Air System Cleaning Specialist certified by NADCA
  .3 Firm: regularly engaged in HVAC system cleaning with minimum 3-years experience
  .4 Employees: trained in safe use of equipment and individual health protection measures
.2 Maintain a copy of all current MSDS documentation and safety certifications for products employed in the cleaning operations at the site at all times. Submit a copy of all MSDS sheets to Owner.
.3 Standards: Conform to NADCA Standard ACR 2013, Assessment, Cleaning and Restoration of HVAC Systems and NADCA Guidelines.
.4 Scope of HVAC System Cleaning Work:
  .1 Clean each HVAC System and component as follows:
    .1 Interior surfaces of all new ductwork and accessories installed as part of this project
    .2 Interior surfaces of all existing ductwork and accessories that are to remain in service on completion of this project,
    .3 Interior surfaces of all new and existing HVAC System components that are to remain in service on completion of this project, including: air handling units, fans, fan housings, air coils, drain pans, humidifiers, filters, filter frames, intake and exhaust and mixing plenums, air blenders, air outlets and inlets, air terminal units, power ventilators, sound attenuators, reheat coils, turning vanes, dampers, and sensors
  .2 Verify the cleanliness of each HVAC System and component through visual inspection, video recording and testing indicated hereinafter.

.5 Cleaning & Disinfection Requirements:
- .1 Conduct visual/video inspections of HVAC Systems and components without disruption of settled dust or debris and without microbial amplification.
- .2 Mark and record position of any and all adjustable devices and ensure that they are re-set to their original position on completion of cleaning and verification work.
- .3 Document and report any and all damage to HVAC Systems and components discovered during inspections to Consultant and to Owner,
- .4 Cleaning: remove all visible surface contaminants and deposits from each HVAC System and component
- .5 Containment: ensure that dust and debris collected during the cleaning process is contained within the HVAC System and not otherwise dispersed outside of the system.
- .6 Odors and Mist control: ensure that odours and mist vapours arising from cleaning operations are contained within the HVAC System and are prevented from escaping to and dispersing outside of the system.
- .7 Provide adequate access into ductwork for cleaning purposes. Provide access doors conforming to project specifications.
- .8 Flexible ducts shall be disconnected to provide access for cleaning.
- .9 Protect components which may be harmed by excessive dirt with filters, or bypass during cleaning.
- .10 Where mechanical brushing and vacuuming is not appropriate or is not sufficient to clean a component of the system, dismantle and remove the component and clean or replace as appropriate.
- .11 Ensure that appropriate liquid collection and drainage measures are in place prior to undertaking any washdown procedures.
- .12 Anti-microbial Agents and Coatings: apply anti-microbial agents where active fungal growth is suspected or where unacceptable levels of fungal contamination exist. Apply anti-microbial treatments and coatings in strict adherence to the manufacturer's written recommendations and registration listings. Application of anti-microbial agents and coatings may be performed only after removal of surface deposits and debris.

.6 Cleanliness Verification:
- .1 Visual Inspection: no visible contaminants present when examined under a bright light (equivalent to 100w incandescent bulb). Maximum 0.75mg/100cm2 with no significant local accumulations.
- .2 Air Coils and reheat coils: restored to within 10% of original design pressure drop

3.5 DUCT LEAKAGE TESTING

.1 Ductwork shall be leak tested in accordance with the SMACNA "HVAC Air Duct Leakage Test Manual". The maximum permitted duct leakage shall be determined by multiplying the leakage factor from paragraph 2.4 above by the surface area of the ductwork in the test zone.

.2 Ductwork that exceeds the maximum permitted leakage shall be re-sealed and re-tested.

.3 Duct leakage test shall be witnessed and certified by the Systems Verification Agency of section 20 01 05.

.4 Record and submit digital copy of test results to the Consultant for review prior to application of duct insulation or concealment of ductwork.

3.6 CONTROLS DEVICES

.1 Install remote sensors such as temperature, pressure and airflow sensors. Supply of sensors and controls wiring will be under Mechanical Section 25.

.2 Install remote mounted control dampers for airflow control. Supply of dampers, damper actuators and controls wiring will be under Mechanical Section 25.

.3 Install duct type smoke detectors in accordance with manufacturer's instructions. Supply of detectors and fire alarm wiring will be under Electrical Division 26.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 33 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Air Turning Devices-Turning Vanes
.2 Air Turning Devices- Extractors
.3 Backdraft Dampers
.4 Volume Control Dampers
.5 Fire Dampers
.6 Fire Dampers (Dynamic)
.7 Combination Smoke/Fire Dampers
.8 Duct access doors.
.9 Duct test holes.
.10 Flexible Duct Connections
.11 Hangers and Supports
.12 Duct Lining
.13 Firestats
.14 Duct Sealants
.15 Motorized dampers
.16 Actuators

1.4 REFERENCES

.1 National Fire Protection Association
    .1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
    .2 NFPA 92A - Smoke-Control Systems.
.2 Sheet Metal and Air Conditioning Contractors National Association
    .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
.3 Underwriters Laboratories
    .1 UL 33 - Heat Responsive Links for Fire-Protection Service.
    .2 UL 555 - Fire Dampers.
    .3 UL 555S - Smoke Dampers.

1.5 SUBMITTALS

.1 Section 20 01 01: Submittals.
.2 Shop Drawings for shop fabricated assemblies including balancing dampers, volume control dampers, duct access doors and duct test holes.
.3 Product Data for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
.4 Manufacturer's Installation Instructions for fire dampers and combination fire and smoke dampers.

1.6 PROJECT RECORD DOCUMENTS

.1 Section 20 01 01: Submittals for project closeout.
.2 Record actual locations of access doors.

1.7 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: CSA Listed as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Transport, handle, store, and protect products.
.2 Protect dampers from damage to operating linkages and blades.

1.9 EXTRA MATERIALS

.1 Section 20 01 01: Submittals for project closeout.
.2 Provide two of each size and type of fusible link.

2 PRODUCTS

2.1 AIR TURNING DEVICES-TURNING VANES

.1 Manufacturers:
  .1 Duro-Dyne
  .2 Duro Vane Rail
  .3 Dyn-Air
  .4 Tuttle and Bailey Grid, Grid-L, Grid-S
  .5 Or approved equivalent.
.2 Turning vanes in rectangular duct elbows shall be double walled, multi-blade vanes with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.2 AIR TURNING DEVICES-EXTRACTORS

.1 Manufacturers:
  .1 Price Model AE1
  .2 Krueger Model EX8
  .3 Duro-Dyne
  .4 Dyn-Air
  .5 Tuttle and Bailey VXR1, VXR2
  .6 Or approved equivalent
.2 Volume extractors: gang operated curved blades, adjustable from full open to full closed positions. Units shall be factory assembled, fabricated from 14 ga. and 22 ga. (2 and .9 mm) steel, with blades on 1" (25 mm) centres, and No. 2 or No. 3 operators to suit application.

2.3 BACKDRAFT DAMPERS

.1 Manufacturers:
  .1 Price
  .2 Duro-Dyne
  .3 Dyn-Air
  .4 Ruskin
  .5 Lawson & Taylor
  .6 Ventex/Alumavent
  .7 Or approved equivalent
.2 Gravity Backdraft Dampers, Size 18" x 18" (450 x 450 mm) or Smaller, Provided with Air Moving Equipment: Air moving equipment manufacturers standard construction.
.3 Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 1/16" (1.5 mm) thick galvanized steel, or, with centre pivoted blades of maximum 6" (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.4 VOLUME CONTROL DAMPERS

.1 Manufacturers:
  .1 Price
  .2 Duro-Dyne

.3 Dyn-Air
.4 Lawson & Taylor
.5 Ruskin
.6 Or approved equivalent

.2 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.3 Splitter Dampers:
.1 Material: Same gauge as duct to 24" (600 mm) size in either direction, and two gauges heavier for sizes over 24" (600 mm).
.2 Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
.3 Operator: Minimum 24" (600 mm) diameter rod in self-aligning, universal joint action, flanged bushing with set screw.

.4 Single Leaf Dampers: fabricated from minimum 20 gauge (1.0 mm) galvanized steel, suitably reinforced to prevent vibration and fitted with indicating regulator.

.5 Multi-Blade Opposed Action Dampers: fabricated from 16 gauge (1.6 mm) galvanized steel, mounted in separate channel frames, reinforced to prevent vibration, and fitted with opposed action linkage hardware.

.6 End Bearings: Except in round ductwork 12" (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

.7 Quadrants:
.1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.
.2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
.3 Where rod lengths exceed 30" (750 mm) provide regulator at both ends.

2.5 FIRE DAMPERS

.1 Manufacturers:
.1 Price
.2 Ruskin
.3 Nailor
.4 Ventex
.5 Pottorff
.6 Or approved equivalent

.2 Fire dampers shall be ULC listed, labelled, or Warnock-Hersey label, meet all requirements of NFPA 90A, and constructed and rated in conformance with:
.1 CAN/ULC-S112-M90, "Standard for Fire Dampers", when used in a fire separation of not more than 2 hours, and which is not a firewall.
.2 CAN/ULC-S112.1-M90, "Standard Method for Fire Tests of Door Assemblies", when used in a fire separation of more than 2 hours or used in a firewall.
.3 CAN/ULC-S112.2-07, "Fire Test of Ceiling Firestop Flap Assemblies", when used in a ceiling fire separation.

.3 Fire dampers shall be galvanized steel channel frame curtain type galvanized steel interlocking blades, minimum 22 gauge (0.9 mm) galvanized steel enclosure, and 160°F (71°C) fusible link standard.

.4 Fire dampers for horizontal installation in vertical ductwork shall be operated by a stainless-steel closure spring and latch.

.5 Fire damper configuration shall be low resistance type B with blades located outside of the air stream for rectangular ductwork, and type C for round or oval ductwork.

.6 Ceiling fire dampers shall be ULC labelled, for fire rated membrane type ceilings, galvanized steel construction with heat retardant blanket (non-asbestos) with standard 160°F (71°C) fusible link.

.7 Thermal blanket shall be ULC labelled, for fire rated membrane type ceilings, to completely enshroud ceiling penetration.

.8 Fire dampers in stainless steel ductwork shall be of all stainless-steel construction.

.9 Fusible Links: UL 33, separate at 160°F (71°C) with adjustable link straps for combination fire/balancing dampers.

2.6 FIRE DAMPERS (DYNAMIC)

.1 Manufacturers:
- .1 Price
- .2 Ruskin DIBD2/DIBD23
- .3 Ventex
- .4 Pottorff
- .5 Nailor
- .6 Or approved equivalent

.2 Dynamic fire dampers tested, constructed and labeled in accordance with the latest edition of UL Standard 555. Dampers shall have a fire rating of 1-1/2 hours or 3 hours and shall meet the requirements of the latest edition of NFPA90A.

.3 Each damper shall include a 165ºF (74ºC) fusible link and shall be labeled for use in dynamic systems. The damper shall be rated for dynamic closure at 2000fpm (10.16m/s) and 4 inches w.g. (1 kPa) static pressure and shall be rated to close with airflow in either direction.

.4 Each dynamic fire damper shall include a steel sleeve and mounting angles furnished by the damper manufacturer to ensure appropriate installation. Submittals information shall include the fire protection rating, maximum velocity/pressure ratings and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with the manufacturer's UL installation instructions.

2.7 COMBINATION FIRE/SMOKE DAMPERS

.1 Manufacturer:
- .1 Ruskin Model FSD60
- .2 Pottorff
- .3 Nailor
- .4 Greenheck
- .5 Price
- .6 AlumaVent/Ventex
- .7 Or approved equivalent

.2 Combination fire/smoke dampers, complete with sleeves and operators, designed and tested to meet both UL555 requirements for fire dampers and UL555S for leakage Class 1 rated smoke dampers. Provide with end switches. Construct frame from 1.6mm (16 gauge) galvanized steel. Construct single piece construction air foil blades from 2.0mm (14 gauge) galvanized steel, with stainless steel sleeve bearings, square plated steel axles and concealed linkages. Use stainless steel spring. Design for operator mounted out of the air stream. Equip with 120 degrees C (250-degree F) snap disc. Design for operator mounted out of air stream. Provide damper actuators for complete cUL listed and tested damper assembly.

.3 Use only fire damper assemblies tested in accordance with CAN4 S112 M "Standard Method of Fire Test of Fire Damper Assemblies" and listed in most recent ULC "List of Equipment and Materials" or by another recognized independent testing and certification agency acceptance to the Consultant. Label each damper to indicate compliance with these requirements.

.4 Links shall comply with ULC S505 "Standard for Fusible Links for Fire Protection Service".

.5 Fabricate all dampers from galvanized steel except in copper, stainless-steel or aluminum duct systems. In these systems, use all stainless-steel construction.

.6 Fire protection ratings of damper assemblies shall comply with Ontario Building Code requirements for fire resistance ratings of the fire separations through which the protected openings pass. Provide an approval label, stating the fire rating, from a recognized independent testing laboratory acceptable to the Consultant, on each assembly.

.7 Provide detailed installation instructions with each damper. Include illustrations and adequate information to attain proper and safe installation of the smoke/fire damper assembly.

2.8 DUCT ACCESS DOORS

.1 Manufacturers:
- .1 Acudoor
- .2 Duro-Dyne

.3 Dyn-Air
.4 Nailor
.5 Kreuger
.6 Or approved equivalent

.2 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.3 Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum 1" (25 mm) thick insulation with sheet metal cover.
.1 Less Than 12" (300 mm) Square: Secure with sash locks.
.2 Up to 18" (450 mm) Square: Provide two hinges and two sash locks.
.3 Up to 24" x 48" (600 x 1200 mm): Three hinges and two compression latches with outside and inside handles.
.4 Larger Sizes: Provide an additional hinge.

.4 Access doors with sheet metal screw fasteners are not acceptable.

2.9 DUCT TEST HOLES

.1 Manufacturers:
.1 Air Power Co. Dial 1000, Dial 2000
.2 Duro-Dyne TH-1, IP-2, IP-4
.3 Dyn-Air
.4 Or approved equivalent

.2 Provide test ports to suit intended application, (i.e.. insulated/uninsulated duct, round/rectangular duct).

.3 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

.4 Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.10 FLEXIBLE DUCT CONNECTIONS

.1 Manufacturers:
.1 Duro-Dyne
.2 Dyn-Air
.3 Lawson & Taylor
.4 Or approved equivalent

.2 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.3 Connector: Fabric crimped into metal edging strip.
.1 Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m.
.2 Net Fabric Width: Approximately 2" (50 mm) wide.
.3 Metal: 3" (75 mm) wide, 1/32" (0.6 mm) thick.

2.11 HANGERS AND SUPPORTS

.1 Fabricate strap hangers to same material as duct. Hanger configuration to SMACNA details. 20" (500 mm) is maximum duct size to be supported by strap hanger.

.2 Rod and angle hangers: galvanized steel to SMACNA details.

.3 Hanger attachments: manufactured concrete inserts, expansion shields and bolted steel clamps. Do not weld rods to steel decks or use powder actuated fasteners.

2.12 DUCT LINING

.1 Knauf fibre free duct lining: self-sealing engineered polymer foam (3/4") (19mm) thick, complies with:
.1 UL 181 for erosion, mould growth and humidity,
.2 CAN/ULC-102.2, UL 723 and ASTM E84 flame spread (25) and smoke developed (50),
.3 ASTM C665 fungi resistance

.2 AP Armaflex SA Duct Lining (1") (25mm) thick, flexible, closed-cell elastomeric insulation in sheet form meeting following requirements:

.1 ASTM C1534 "Specification for Flexible Polymeric Foam Sheet Insulation Used as a Thermal and Sound Absorbing Liner for Duct Systems"
.2 CAN/ULC-102.2 and ASTM E84 flame spread index of 25 or less and smoke developed index of less than 50.
.3 Maximum thermal conductivity of 0.27 Btu-in./ft2-°F at a mean temperature of 75°F
.4 Maximum water absorption rate of 0.2% (by volume) to ASTM C209
.5 Maximum vapour transmission rate of 0.08 perm-inches to ASTM E96, Procedure A
.6 Approved for installation in air plenums
.7 NFPA 90A, NFPA 90B and UL 181 Class 1 specifications.
.8 ASTM C411, materials perform up to 250°F
.9 ASTM C1071 erosion resistance
.10 ASTM G21 and ASTM C1338 fungi resistance
.11 ASTM G22 bacterial resistance
.12 Dust free, fibre free, non-particulating

2.13 DUCT SEALANT

.1 General: Low VOC, water-based sealant, non-toxic, non-combustible, non-flammable, and tested in accordance with CAN4/ULC-S102. Flame spread shall not exceed 25 and smoke developed shall not exceed 50.
.2 Acceptable Products: Multi-Purpose Duct Sealant as manufactured by Trans Continental Equipment, Duro Dyne SWB Duct Sealer, Iron Grip 601 as supplied by Alpha Sheet Metal Co., or Uni-Grip Duct Sealer from United McGill Corporation.

2.14 MOTORIZED DAMPERS-EXPOSED TO OUTDOOR AIR

.1 Manufacturers:
  .1 Tamco series 9000 thermally insulated damper
  .2 Ruskin
  .3 Nailor
  .4 Alumavent/Ventex.
  .5 Or approved equivalent
.2 Extruded aluminum (6063-T5) damper frame shall not be less than .080" (2.03mm) in thickness. Damper frame to be 4" (100mm).
.3 Blades to be extruded aluminum (6063-T5) air foil profiles, internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
.4 Blade seals shall be of extruded EPDM. Frame seals shall be of extruded silicone. Seals to be secured in an integral slot within the aluminum extrusions.
.5 Maintenance-free bearings are to be composed of a Celcon inner bearing fixed to a 7/16" (11.11mm) aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
.6 Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
.7 Dampers are to be designed for operation in temperatures ranging between -72°F (-58°C) and 185°F (85°C).
.8 Dampers shall be opposed blade for modulating applications, and parallel for open/close applications.
.9 Leakage shall not exceed 3 cfm/ft² (15.2 l/s/m²) against 1" (.25 kPa) w.g. differential static pressure.
.10 Pressure drop of a fully open 48" x 48" (1200mm x 1200mm) damper shall not exceed .03" (.007kPa) w.g. at 1000 fpm (5.08 m/s).
.11 Dampers shall be made to size required without blanking off free area.
.12 Dampers shall be available in two mounting types: i.e., "Installed in Duct" or "Flanged to Duct".

2.15 MOTORIZED DAMPERS-EXPOSED TO TEMPERED AIR

.1 Manufacturers:
  .1 Tamco series 1500 enhanced air-foil damper
  .2 Ruskin

.3 Nailor
.4 Alumavent/Ventex.

.2 Extruded aluminum (6063-T5) damper frame shall not be less than .080" (2.03mm) in thickness. Damper frame to be 4" deep.
.3 Blades to be extruded aluminum (6063-T5) profiles. Aluminum end caps are to be press fitted to blade ends,in order to seal hollow interior and reduce air leakage rate.
.4 Blade and frame seals shall be of extruded silicone. Seals are to be secured in an integral slot within the aluminum extrusions.
.5 Maintenance-free bearings are to be composed of a Celcon inner bearing fixed to a 7/16" (11.11mm) aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
.6 Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
.7 Dampers are to be designed for operation in temperatures ranging between -72°F (-58°C) and 212°F (100°C).
.8 Dampers shall be opposed blade for modulating applications, and parallel for open/close applications.
.9 Leakage shall meet Class 1A at 1" w.g. static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
.10 Pressure drop of a fully open 48" x 48" (1200mm x 1200mm) damper shall not exceed .02" (.004kPa) w.g. at 1000 fpm (5.08 m/s).
.11 Dampers shall be made to size required without blanking off free area.
.12 Dampers shall be available in two mounting types: i.e., "Installed in Duct" or "Flanged to Duct".

2.16 ELECTRONIC DAMPER ACTUATORS

.1 Manufactured, brand labeled or distributed by Belimo or approved equivalent.
.2 Size for torque required for damper seal at load conditions.
.3 Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
.4 Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
.5 Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent any damage to the actuator during a stall condition.
.6 Fail-Safe Operation: Mechanical, spring-return mechanism.
.7 Power Requirements (Spring Return): 120 V ac, maximum 10 VA at 24-V ac or 8 W at 24-V dc.
.8 Proportional Actuators shall be fully programmable. Control input, position feedback and running time shall be factory or field programmable by use of external computer software Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload and mechanical travel. Programming shall be through an EEPROM without the use of actuator mounted switches.
.9 Temperature Rating: -22 to +122ºF (-30 to +50ºC)
.10 Housing: Minimum requirement NEMA type 2 mounted in any orientation.
.11 Agency Listing: ISO 9001, cULus, and CSA C22.2 No. 24-93.
.12 The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

3 EXECUTION

3.1 PREPARATION

.1 Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

.1 Install accessories to manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
.2 Provide motorized backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
.3 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic

dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8" x 8" (200 x 200mm) size for hand access, 18" x 18" (450 x 450 mm) size for shoulder access, and as indicated. Provide 4" x 4" (100 x 100 mm) for balancing dampers only. Review locations prior to fabrication.

.4 Provide duct test holes where indicated and required for testing and balancing purposes.

.5 Provide fire dampers, combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.6 Install smoke dampers and combination smoke and fire dampers to NFPA 92A.

.7 Install duct type smoke detectors in accordance with manufacturer's instructions where required in Mechanical Division 25 Controls and Instrumentation and in Electrical Division 26 Fire Alarm and Emergency Voice Communications. Coordinate with Electrical Division 26 required connections.

.8 Demonstrate re-setting of fire dampers to Owner's representative.

.9 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators. For fans developing static pressures of 1250 Pa and over, cover connections with loaded vinyl sheet, held in place with metal straps.

.10 Use splitter dampers only where indicated.

.11 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

.12 Install control dampers supplied under Mechanical Division 25 in ducts or plena as indicated.

.13 Provide turning vanes where space restrictions prohibit the use of elbows having a minimum inside radius equal to the duct width for horizontal elbows or the duct depth for vertical elbows.

.14 Provide test ports as required by Balancing Agency to completely test and balance the system. No temporary holes will be permitted in ductwork or flexible connections.

3.3 FIRE DAMPERS

.1 Provide fire dampers where shown on drawings. In general, fire dampers are required where ducts pass through fire rated assemblies, floors and roofs and ducts entering and leaving duct shafts and mechanical rooms.

.2 Install fire dampers in strict accordance with manufacturer's installation instructions and in conformance with NFPA 90A.

.3 Install type A fire dampers anywhere there are extreme space limitations and then only where dimension of duct exceeds 12" (300 mm) in direction of blade closing and is specifically approved by Consultant.

.4 Install type B fire dampers for rectangular ductwork.

.5 Install type C fire dampers for round or oval ductwork.

.6 Openings for fire dampers must be properly prepared and the fire dampers installed and secured prior to field review by the Consultant. Notify the Consultant when ready for review. Do not make any duct connections to fire dampers until review is complete and work found correct.

.7 Support fire dampers from building structure. Submit erection Drawings, approved by all authorities, showing the locations and construction details of all fire dampers before proceeding with any work.

.8 Install Ceiling Fire Dampers where ducts serve grilles and diffusers in rated ceilings. Support from building structure.

.9 Install thermal blanket in all fire rated membrane type ceilings. Thermal blanket shall be wrapped and stapled around the unexposed perimeter of diffuser after installation of ceiling damper following manufacturer's installation instructions.

.10 Use Dynamic Fire Dampers for Systems expected to be Operational during a Fire.

3.4 COMBINATION FIRE/SMOKE DAMPERS

.1 Provide fire/smoke dampers where indicated and where required by building authorities under the building code.

.2 Install fire/smoke dampers in accordance with manufacturer's instructions and listing conditions.

.3 Integrate operation of the fire/smoke dampers with the fire alarm and the building control systems. Coordinate with Divisions 25 and 26.

3.5 DUCT ACCESS DOORS

.1 Provide duct access doors of suitable size in ductwork in the following locations:
- .1 Suction inlet of all fans
- .2 At not more than 40’-0” (12 metre) intervals
- .3 At not more than 20’-0” (6 metre) intervals on the ductwork installed after a high efficiency filter
- .4 At the base of all main risers
- .5 In front of and behind all coils
- .6 At all fire, smoke, and motorized dampers
- .7 At all locations having an internally mounted piece of equipment or device. Provide a section of transparent plexiglass to permit viewing without opening the access doors.
- .8 Where required for duct cleaning.

.2 Wherever possible, doors shall be mounted to close in direction of air flow.

3.6 DUCT LINING

.1 Line internal surfaces of all ductwork shown cross hatched on drawings with 1" (25 mm) thick duct lining.
.2 No allowance has been made in duct sizes indicated for internal lining. Increase duct size 1" (25 mm) all around where lining is to be internally applied.
.3 Adhere directly to clean, oil-free surfaces with full coverage of flame-resistant adhesive.
.4 Ambient temperature must be between 40°F and 100°F (4.4°C and 37.8°C)
.5 Armaflex:
- .1 Smooth side shall be exposed to airstream.
- .2 Butt edges tightly with a compression fit. Overlap the insulation 1/4" (7 mm) at the butt-edges and compress edges into place. Leave a 1/2" (13 mm) wide release liner border at the butt edge.
- .3 Apply metal nosing to every leading edge for air velocities over 4000-fpm (20.3m/sec.)

3.7 FIRESTATS

.1 Provide 135°F (57°C) firestats in return air ductwork of all supply units greater than 2000 CFM capacity.
.2 Provide 135°F (57°C) firestats in all exhaust systems greater than 2000 CFM capacity.
.3 Provide 235°F (112°C) firestats in discharge of all supply air units greater than 2000 CFM capacity.
.4 Wire firestats under this Section unless indicated otherwise in Mechanical-Electrical Schedule.
.5 Provide firestats in accordance with NFPA 90A.

3.8 MOTORIZED DAMPERS

.1 Installation of dampers must be in accordance with current manufacturer's installation guidelines provided with each shipment of dampers.
.2 Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width. See manufacturer's installation guidelines.

3.9 ELECTRONIC DAMPER ACTUATORS

.1 Provide electronic damper actuators for each motorized damper.
.2 Power wiring and interconnections to associated fan control will be under Electrical Division 26.
.3 Refer to Section 25 30 00 Controls and Instrumentation for responsibility matrix.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.
.2 Refer to section 20 05 30 Supports and Anchors for steel structures.

1.2 COMMON WORK RESULTS

.1 Section 23 34 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Roof Downblast Exhaust Fan
.2 Inline Centrifugal Fan
.3 Ceiling Exhaust Fan
.4 Dryer Exhaust Booster
.5 Lint Traps

1.4 REFERENCES

.1 AMCA International
    .1 AMCA 99 - Standards Handbook.
    .2 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
    .3 AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
    .4 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
    .5 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
.2 Underwriters Laboratories
    .1 UL 705 - Power Ventilators.
.3 National Fire Protection Association
    .1 NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems
    .2 NFPA 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

1.5 SUBMITTALS

.1 Section 20 01 01: Procedures for submittals.
.2 Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, dimensional drawings for each fan, with flow, static pressure, horsepower, sound power levels at rated capacity, and electrical characteristics and connection requirements.
.3 Manufacturer's Installation Instructions.

1.6 OPERATION AND MAINTENANCE DATA

.1 Section 20 01 01: Submittals for project closeout.
.2 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.7 EXTRA MATERIALS

.1 Section 20 01 01: Submittals for project closeout.
.2 Provide two sets of belts for each fan.

2 PRODUCTS

2.1 DOWNBLAST ROOF EXHAUST FAN

.1 Cook ACE-D VF or equivalent products by:

.1 PennBarry
.2 Twin City
.3 Greenheck
.4 Carnes
.5 Or approved alternate

.2 Product Requirements:
.1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
.2 Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
.3 Fabrication: Conform to AMCA 99.

.3 Performance: as scheduled on drawings

.4 Fan Unit: direct driven with electronically commutated motor, all aluminum housing, backward inclined all aluminum wheel, two-piece cap with stainless steel quick release latches, welded curb cap corners, resilient mounted motor, backdraft damper, corrosion resistant fasteners, permanently lubricated ball bearing motors, 1/2" (13 mm) mesh, .08" (2 mm) 16-gauge aluminum bird screen; square base to suit roof curb with continuous curb gaskets.

.5 Roof Curb: 18" (457mm) high self-flashing of aluminum with continuously welded seams, built in cant strips, and factory installed nailer strip. Curbs shall be reviewed/designed by a seismic engineer licenced in the Province of Ontario. Stamped shop drawings shall be submitted for review by Consultants and Owner.

.6 Electrical Characteristics and Components
.1 Electrical Characteristics: as scheduled
.2 Motor: Refer to Section 20 05 00.
.3 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.
.4 Disconnect Switch: NEMA 3R, Factory wired, non-fusible, in housing for thermal overload protected motor, outdoor application. Wired from fan motor to junction box within motor compartment.

.7 Backdraft Damper: gravity backdraft damper, aluminum multi-blade construction.

2.2 INLINE CENTIRFUGAL FAN – DIRECT DRIVE

.1 Cook SQN-D VF or equivalent products by:
.1 Penn Barry
.2 Twin City
.3 Greenheck
.4 Carnes
.5 Or approved alternate

.2 Product Requirements:
.1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
.2 Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
.3 Fabrication: Conform to AMCA 99.

.3 Performance: as scheduled on drawings

.4 Duct mounted fan shall be of the centrifugal, direct-driven, square inline type. The fan housing shall be of a square design construction of heavy-gauge galvanized steel and shall include square duct mounting collars. Motor shall be electronically commutated.

.5 Fan construction shall include three removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.

.6 The fan wheel shall be centrifugal, backward-inclined, constructed of aluminum, and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be readily accessible for maintenance.

.7 A NEMA-1 disconnect switch shall be provided as standard. Factory wiring shall be provided from motor to the handy box.

.8 All fans shall bear the AMCA Certified Ratings Seal for Sound and Air Performance.

.9 Fan shall bear a permanently affixed manufacturer’s nameplate containing the model number and

individual serial number for future identification.

2.3 CEILING MOUNTED INLINE EXHAUST FAN

.1 Cook GCVF or equivalent product by:
  .1 Penn Barry
  .2 Twin City
  .3 Greenheck
  .4 Carnes
  .5 Or approved alternative
.2 Ceiling mounted, direct drive centrifugal exhaust fan.
.3 Product Requirements:
  .1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
  .2 Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
  .3 Fabrication: Conform to AMCA 99.
.4 Fan wheel housing and integral outlet duct shall be infection molded resin exceeding UL requirements for smoke and heat generation. Wheel shall be centrifugal forward curved type, balanced in accordance with AMCA 204-05.
.5 Motor shall be totally enclosed with permanently lubricated bearings, built in overload protection and disconnect plug.
.6 Backdraft damper: all aluminum with continuous aluminum hinge rod.
.7 Inlet box shall be minimum 22 gauge galvanized steel.
.8 Motor shall be isolation mounted o a one piece galvanized stamped steel integral motor mount.
.9 Field wiring compartment with disconnect receptable.
.10 Pre-punched mounting bracket shall be provided.
.11 Control: Fan runs on activation by light switch, occupancy sensor, or motion sensor. A High/Low delay timer (adjustable from 30 sec. to 60 min.) stops or slows the fan to the minimum cfm after a delay set by the User.

2.4 DRYER BOOSTER EXHAUST FANS

.1 Manufacturers:
  .1 Reversomatic PWS-300
  .2 Fantech
  .3 Zonex
  .4 Or approved alternate
.2 Casing: Heavy gauge satin coated steel.
.3 Wheel: Aluminum self-cleaning paddle wheel design to prevent lint buildup.
.4 Accessories: Mounting brackets, transitions and heavy-duty wall cap.
.5 Electrical: 120 Volts, 1 Phase, 60 Hz, 1550 RPM.
.6 Performance: as scheduled on drawings.

2.5 LINT FILTERS

.1 Manufacturers:
  .1 Reversomatic LT180 and LT200.
  .2 Fantech DBLT4W
  .3 Or approved alternate
.2 Galvanized steel or aluminum construction. Removable plexiglass cover. Equipped with filter frame attached to the removable door for easy operation. Suitable for drywall installation ceiling or wall mounted.

3 EXECUTION

3.1 INSTALLATION

.1 Install fans in accordance with manufacturer's instructions.

.2 Provide flexible duct connections between each fan and ductwork. Ensure metal bands of connectors are parallel with minimum 1" (25 mm) flex between ductwork and fan while running.

.3 Provide sheaves as required for final air balance.

.4 Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

.1 Roof Exhaust Fan:

.2 Secure roof exhausters with stainless steel lag screws to roof curb.

.3 Extend ducts to roof exhausters into roof curb. Counter flash duct to roof opening.

.4 Install motorized backdraft dampers on inlet to roof and wall exhausters.

.5 Cabinet Exhaust Fans:

.1 Support exhaust fans independently of ductwork.

.2 Provide motorized backdraft dampers on outlet.

.6 Dryer Exhaust Fan:

.1 Locate booster fan and lint trap in a readily accessible location as determined with the Consultant on site.

.7 Dryer Lint Trap:

.1 Locate lint trap in a readily accessible location as determined with the Consultant on site.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 37 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Diffusers
.2 Grilles and Registers

1.4 REFERENCES

.1 ADC 1062 - Air Distribution and Control Device Test Code.
.2 AMCA 500 - Method of Testing Louvres for Ratings.
.3 AMCA 5000 - Method of Testing Dampers for Ratings.
.4 AHRI 650 - Air Outlets and Inlets.
.5 ASHRAE 70 - Method of Testing for Rating the Performance of Outlets and Inlets.
.6 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
.7 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.5 SUBMITTALS

.1 Section 20 01 01: Procedures for submittals.
.2 Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
.3 As built record drawings to record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

.1 Test and rate air outlet and inlet performance to ADC Equipment Test Code 1062 and ASHRAE 70.
.2 Test and rate louvre performance to AMCA 500.

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Diffusers, grilles and registers shall be Price model indicated or equivalent products by:
  .1 Titus
  .2 Kreuger
  .3 Metalaire
  .4 Nailor
  .5 Carnes
  .6 Or approved alternate

2.2 SQUARE CONE DIFFUSERS, FIXED PATTERN

.1 Manufacturer's Reference: Price Model SCD/31/3C/B12
.2 Type: Square, fixed pattern, stamped, multi-core diffuser to discharge air in 360-degree pattern with

sectorizing baffles where indicated.

.3 Frame: Inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.

.4 Fabrication: Steel with baked enamel off-white finish.

.5 Accessories: Radial opposed blade damper and multi-louvred equalizing grid with damper adjustable from diffuser face.

2.3 CEILING GRID CORE GRILLES RETURN/EXHAUST

.1 Manufacturer’s Reference: Price Model 80DAL.

.2 Type: Fixed grilles of 1/2”x1/2”x1/2” (13x13x13mm) grid (egg crate core) with extruded aluminum border.

.3 Frame: 1-1/4” (32mm) margin with concealed mounting. Channel lay-in frame for suspended grid ceilings.

.4 Fabrication: Aluminum with B12 White Powder Coat finish.

.5 Damper: Integral, Aluminum, gang-operated, opposed blade type with removable key operator, operable from face.

3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

.3 Install diffusers and grilles and connect to ductwork with airtight connections.

.4 Provide balancing dampers in duct take-off to diffusers, grilles and registers, whether or not dampers are included as part of the diffuser, grille or register assembly.

.5 Paint visible ductwork behind air outlets and inlets matte black.

.6 Install filters in diffusers, grilles and registers after final cleaning of rooms and ductwork has been completed and accepted and when environmental conditions are suitable. Ensure that airtight seal is achieved.

3.2 PROTECTION

.1 Protect each diffuser, grille and register from damage during construction.

.2 Protect each diffuser, grille, register and ductwork from contamination and entry of dust and debris during construction.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 37 20 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Louvres

1.4 REFERENCES

.1 AMCA 500 - Method of Testing Louvres for Ratings.
.2 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
.3 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.5 SUBMITTALS

.1 Section 20 01 01: Procedures for submittals.
.2 Manufacturer shall submit shop drawings incorporating key plans, elevations, sections and details showing profiles, angles and spacing of louvre & penthouse blades and frames; unit dimensions related to wall openings and construction; and anchorage details and locations. For each type of product specified, submit free area, air performance and water penetration ratings based on the performance of louvre proposed determined in accordance with AMCA Standard 500-L and licensed under the AMCA Certified Ratings Program. Include compliance with applicable code. Provide samples of manufacturer's finish and color charts showing the full range of colors available.

1.6 PROJECT RECORD DOCUMENTS

.1 Section 20 01 01: Submittals for project closeout.
.2 Record actual locations of louvres and vents

1.7 QUALITY ASSURANCE

.1 Test and rate louvre performance to AMCA 500

1.8 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum fifteen years documented experience.

1.9 PROJECT CONDITIONS

.1 Field Measurements: Verify louvre openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  .1 Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvres without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

1.10 PERFORMANCE REQUIREMENTS

.1 Definitions
  .1 Louvre Terminology: Definitions of terms for metal louvres contained in AMCA 501 apply to

this Section, unless otherwise defined in this Section or in referenced standards.

.2 Standard Free Area: Free area of a louvre 48 inches (1220 mm) wide by 48 inches (1220 mm) high, identical to that provided.

.3 Maximum Standard Airflow: Airflow at point of beginning water penetration through a louvre 48 inches (1220 mm) wide by 48 inches (1220 mm) high, identical to that provided.

.4 Drainable-Blade Louvre: Louvre designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions.

.5 Minimum Weather Louvre Effectiveness: Weather louvre effectiveness rating shall be based on tests conducted in accordance with:

.1 AMCA Standard 500-L-99.

.2 Performance Requirements

.1 Structural Performance: Provide exterior metal louvres capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louvre components including blades, frames, and supports; noise or metal fatigue caused by louvre blade rattle or flutter; or permanent damage to fasteners and anchors.

.1 Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft. (1440 Pa), acting inward or outward.

.2 Thermal Movements: Provide louvres that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects:

.1 Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

.2 Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvres complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 48 inches (1220 mm) wide by 48 inches (1220 mm) high. Test units according to AMCA 500.

.1 Perform testing on unpainted, cleaned, degreased units.

.2 Perform water-penetration testing on louvres without screens.

.3 Weather Louvre Effectiveness: Provide louvres complying with performance requirements indicated, as demonstrated by testing manufacturer’s stock units for a 60 minute test in accordance with AMCA Standard 500-L-99, Section 8.3.2 - Wind Driven Rain Water Penetration Test.

.3 Quality Assurance

.1 Source Limitations: Obtain louvres and vents through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory-applied color finish.

.2 Welding Standards: As follows:

.1 Comply with AWS D1.2, "Structural Welding Code--Aluminum."

.2 Comply with AWS D1.3, "Structural Welding Code--Sheet Steel."

.3 Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

.3 AMCA Standard 500-L-99: Air performance, water penetration and air leakage ratings shall be determined in accordance with Air Movement and Control Association International Inc (AMCA) Standard 500, "Laboratory Methods of Testing Louvres for Rating."

.4 AMCA Standard 511: Air performance, water penetration and air leakage ratings shall be licensed in accordance with Air Movement and Control Association International Inc. (AMCA) Standard 511, "Certified Ratings Program for Air Control Devices," latest edition.

.5 SMACNA Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

.4 Project Conditions

.1 Field Measurements: Verify louvre openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

.1 Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvres without field measurements. Coordinate construction to ensure that actual opening

dimensions correspond to established dimensions.

2 PRODUCTS

2.1 BASIS OF DESIGN

.1 Price
  .1 Other acceptable manufacturers meeting specifications
    .1 Construction Specialties
    .2 Aerolite
    .3 Ventex
    .4 McGIll
    .5 Or approved alternate

2.2 LOUVRES (DRAINABLE)

.1 General: Drainable Louvre furnished with bird screen, insect screen, supports, installation hardware and finishes as specified and as required for a complete installation.

.2 Products: Louvres shall be drainable louvre with visible vertical mullions (concealed vertical mullions). Louvres shall be 4-inches (152.4 mm) deep and assembled entirely from extruded aluminum components. Blades and frames shall be 0.081-inch (2.0 mm) thick extruded aluminum, alloy 6063-T5. Blades shall be stationary, incorporate drainable gutters, and be spaced 4-inches (101.6 mm) on center. Jamb frames shall incorporate drainable gutters to ensure resistance to water penetration.

.3 Optional Welded Assembly: Join stationary blade, head and jamb frames with fillet welds concealed from view, unless the size of the louvre makes bolted connections between louvre sections necessary. Louvre blades shall be joined to each jamb frame with a minimum of two fillet welds produced with the Pulsed Gas Metal Arc Welding (GMAW/Mig) process. Each weld shall be a minimum of 1-inch (25.4 mm) in length with a minimum 1/8-inch (3.175 mm) leg. Frames shall be joined at each corner with a full-length GMAW fillet weld with a minimum 1/8-inch (3.175 mm) leg.

.4 Structural Design Criteria: Manufacturer shall design and furnish all supports required to withstand a wind force of not less than 25 pounds per square foot. Louvres 120-inches wide x 84-inches high or 84-inches wide by 120-inches high will be fabricated and installed in multiple sections. Louvre blades, frames, mullions and anchorages shall be demonstrated to withstand the specified wind design load.

.5 Performance Ratings:
  .1 Free Area: 9.41 Square Feet (0.88 m2)
  .2 Minimum Free Area Velocity (at Beginning Point of Water Penetration): 1,077 fpm (5.47 m/s)
  .3 Minimum Air Volume Flow Rate (at Beginning Point of Water Penetration): 10,135 cfm (4.78 m3/s)
  .4 Maximum Static Pressure (at Beginning Point of Water Penetration): 0.15 in. H2O (0.037 kPa)

.6 Finishes: Color Anodize: Louvres shall be finished with a Class I electrolytically color anodized coating (AA-M10C22A42/44) that complies with the performance requirements of AAMA Specification 611-98, "Voluntary Specification for Anodized Architectural Aluminum." Color shall be (select one): Champagne, Light Bronze, Medium Bronze, Dark Bronze, Extra Dark Bronze or Black Anodize.

.7 Acceptable Model: Price DE439

3 EXECUTION

3.1 PREPARATION

.1 Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

.2 Comply with Manufacturer’s instructions.

3.2 INSTALLATION

.1 Locate and place louvres level, plumb, and at indicated alignment with adjacent work.

.2 Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where

required to protect metal surfaces and to make a weather tight connection.

.3 Form closely fitted joints with exposed connections accurately located and secured.

.4 Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

.5 Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

.6 Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

.7 Install concealed gaskets, flashings, joint fillers, and insulation, as louvre installation progresses, where weather tight louvre joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louvre installation.

3.3 ADJUSTING, CLEANING AND PROTECTING

.1 Periodically clean exposed surfaces of louvres and vents that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

.2 Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

.3 Protect louvres and vents from damage during construction. Use temporary protective coverings where needed and approved by louvre manufacturer. Remove protective covering at the time of Substantial Completion.

.4 Restore louvres and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

.1 Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 52 16 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Boilers.
.2 Controls and boiler trim.
.3 Hot water connections.

1.4 REFERENCES

.1 CSA
  .1 CSA B51 Boiler, Pressure Vessel and Pressure Piping Code as adopted
.2 The American Society of Mechanical Engineers
  .1 ASME SEC 4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.
  .2 ASME SEC 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.
.3 HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.
.4 National Electrical Manufacturers Association
  .1 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.5 SUBMITTALS

.1 Refer to Division 20 01 01 procedures for submittals.
.2 Product Data: Provide data indicating general layout, dimensions, and size and location of water, gas, and vent connections, and electrical characteristics and connection requirements.
.3 Submit manufacturer's installation instructions.
.4 Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.
.5 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.6 REGULATORY REQUIREMENTS

.1 CSA B51 Boiler, Pressure Vessel and Pressure Piping Code as adopted
.2 Conform to ASME SEC 4 and SEC 8D for boiler construction.
.3 Units: CSA/CGA certified.
.4 Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND PROTECTION

.1 Transport, handle, store, and protect products.
.2 Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.8 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.9 WARRANTY

.1 The heat exchanger shall carry a non-prorated 10-year warranty against failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.
.2 All other components and controls supplied with the boiler shall carry a 2 year warranty against failure due to defective materials or workmanship.
.3 Boiler must be registered with the manufacturer at time of start up with warranty card and start up report.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Basis of Design: Precision Compac
.2 Other acceptable manufacturers:
  .1 Lochinvar
  .2 Thermo 2000 Voltmax
  .3 Or approved alternate

2.2 GENERAL

.1 Furnish and install as shown on the plans electric hot water boiler, fabricated per these specifications, including all accessories and construction features as described herein.
.2 Boilers shall be completely factory assembled and pre-tested prior to shipment.
.3 Boilers shall be UL labeled and comply with CSD-1. Boiler shall include an ASME Section IV pressure vessel which has been fabricated under inspection by an authorized inspector holding a National Board commission and subsequently stamped and National Board registered.

2.3 BOILER

.1 Pressure Vessel
  .1 The pressure vessel and all trim shall be as set forth in the ASME Code, including ASME “HV” stamped safety relief valve sized as required.
  .2 The vessel shall be provided with a threaded 3” (4” flanged) inlet and a threaded 3” (4” flanged) outlet, plus safety valve and drain nozzle as required.
  .3 The pressure vessel shall be housed in a 16-gauge steel enclosure allowing 4 inches of insulation space around the vessel and filled with 4 inches of 3/4 pound-density fiberglass insulation.
  .4 The electric panel and vessel shall be mounted on a common, structural steel base.
  .5 The boiler shall have a modulating input rating and output rating as scheduled.
.2 Internal Power Distribution
  .1 The power distribution shall be through cable connection to mechanical lugs.
  .2 Power shall be fed through current limiting fuses to magnetic contactors, and then to the heating element circuits.
  .3 Contactors shall be 3-pole magnetic contactors tested by UL for 500,000 cycles at full load.
  .4 The coil voltage shall be 120-volts.
  .5 Internal wiring shall be in accordance with NEC/NFPA Article 424-G and UL Subject 834.
.3 Heating Elements
  .1 Elements shall be individually mounted in steel flanges. The flange size shall not exceed 2-1/2 inches square, with a maximum of three single- bend U-shaped element blades per flange. Element sheath material shall be Incoloy; element watt density shall be 75 WSI.
.4 Controls
  .1 The control circuit shall be 120-volt single-phase, one side grounded.
  .2 Control voltage shall be provided by an integral control circuit transformer.
  .3 The controls shall include an ON/OFF switch, temperature controller, solid state step control, indicator lights and manual limiting switches for each stage of heating, a low water cut-off with test/reset buttons, and one auto reset and one manual reset high limit temperature switch.

.4 Local switch and remote reset of setpoint to integrate with BAS.

.5 Accessories

.1 Low water cut-of.

3 EXECUTION

3.1 INSTALLATION

.1 Install to manufacturer's instructions.

.2 Install boiler on concrete housekeeping base, sized minimum 4” (100 mm) larger than boiler base.

.3 Provide piping connections and accessories. Each boiler shall have individually isolating shutoff valves for service and maintenance.

.4 Pipe relief valves to nearest floor drain.

.5 Install circulator and expansion tank on boiler.

.6 Provide for connection to electrical service.

3.2 MANUFACTURER'S FIELD SERVICES

.1 A manufacturer's factory authorized service technician must be used to start-up and service the boilers.

.2 Instruct operating personnel in the operation and maintenance of units.

3.3 TSSA INSPECTION

.1 The contractor is to arrange and pay for inspection by the local TSSA inspector prior to boiler start-up. Make modification required by the authorities having jurisdiction (AHJ). Include a copy of TSSA certificate of inspection with close-out documentation as per General Requirements of 20 01 01.

END OF SECTION

1 GENERAL

1.1 GENERAL

.1 Comply with General Requirements of Section 20 01 01.

1.2 SECTION INCLUDES

.1 Packaged roof top unit.
.2 Unit controls.
.3 Remote panel.
.4 Roof mounting curb and base.
.5 Maintenance service.

1.3 REFERENCES

.1 AHRI 210/240 - Unitary Air-Conditioning and Air Source Heat Pump Equipment.
.2 AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
.3 AHRI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
.4 ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
.5 ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
.6 ASHRAE 90.1–2010 – Energy Standard for Buildings Except Low-Rise Residential Buildings
.7 CSA B-52– Mechanical Refrigeration Code
.8 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
.9 NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

1.4 SUBMITTALS FOR REVIEW

.1 Section 20 01 01: Procedures for submittals.
.2 Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
.3 Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
.4 Submissions for Information: Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, operation and service clearances and include start-up instructions.
.5 Submittals for project closeout: Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
.6 Authorized service/sales representative contact name

1.5 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
.2 AHRI Compliance:
  .1 Comply with AHRI 210/240 and AHRI 340/360 for testing and rating energy efficiencies for RTUs.
  .2 Comply with AHRI 270 for testing and rating sound performance for RTUs.
.3 NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
.4 Energy Compliance: Comply with 90.1-2010 – Energy Standard for Buildings

1.6 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND PROTECTION

.1 Section 20 01 01: Transport, handle, store, and protect products.
.2 Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.
.3 Follow manufacturer’s recommendations for transport, rigging and unloading.

1.8 WARRANTY

.1 Section 20 01 01: Submittals for project closeout.
.2 Warranty Period:
  .1 Parts and Labour: Minimum one year from date of Substantial Completion
  .2 Compressors: Minimum five years from date of Substantial Completion.
  .3 Heat Exchangers: Minimum five years from date of Substantial Completion.

1.9 EXTRA MATERIALS

.1 Section 20 01 01: Submittals for project closeout.
  .1 Provide one set of filters.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Basis of Design: AAON
.2 Acceptable alternates:
  .1 Daikin
  .2 Trane
  .3 Valent
  .4 Or acceptable equivalent

2.2 UNIT CONSTRUCTION AND COMPONENTS

.1 Air source heat pump complete with backup electric heating. Units shall be provided with vertical discharge (from below units). Units shall be factory assembled, tested and shipped as a complete packaged assembly, for rooftop mounting, consisting of the following:
  .1 Compressors
  .2 Evaporator coils
  .3 Air cooled condenser coils
  .4 dampers
  .5 electric heaters
  .6 centrifugal supply fan c/w VFD
  .7 condenser fans
  .8 motor starter with thermal overload protection
  .9 motor and drive assembly
  .10 safety equipment
  .11 temperature control system
  .12 roof curb
.2 Approvals: Unit assembly shall be tested in accordance with Standard, ANSI Z83.8-2006 and CSA 2.6-2006 and shall bear the ETL label.
.3 Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the

unit in the service compartment's literature pocket.

.4 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

.5 Unit components shall be labeled, including and electrical and controls components.

.6 Estimated sound power levels (dB) shall be shown on the unit ratings sheet.

.7 Installation, Operation, and Maintenance manual shall be supplied within the unit.

.8 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

.9 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

.10 Housing:

.1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

.2 Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.

.3 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel, and prevents exterior condensation on the panel.

.4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

.5 Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

.6 Access to filters, dampers, cooling coils, heaters, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full-length stainless-steel piano hinges shall be included on the doors.

.7 Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

.8 Units with cooling coils shall include double sloped 304 stainless steel drain pans.

.9 Unit shall be provided with base discharge opening and no return air opening. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.

.10 Unit shall include lifting lugs on the top of the unit.

.11 Unit base shall be fabricated of 1-inch-thick double wall, impact resistant, rigid polyurethane foam panels.

.12 Unit shall include factory installed welded wire mesh screen on the face of the condenser coil.

.13 All gas valves and electrical safety-limits shall be mounted within the burner vestibule; wiring to these components shall be properly secured and away from all high temperature metal surfaces. The burner vestibule shall be an integral part of the unit and not extend outside the exterior casing of the unit and not exposed to the main air stream.

.14 High wind rain caps shall be installed at the termination of the furnace discharge flues.

.15 Roof Curb: shall be 24" high.

2.3 FANS

.1 Supply fan shall be direct drive backward curved, plenum style. Exhaust fan shall be direct drive, backward curved, plenum style, and sized for 100% relief. Exhaust fan shall include barometric relief dampers. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. Fans shall be direct drive to eliminate all belt maintenance issues.

.2 Unit shall have a heavy-duty, solid-steel shaft. Wheels shall be balanced in two planes and done in

accordance with AMCA standard 204-96. The wheel blades shall be aerodynamically designed. The wheel blades shall be securely attached to the wheel inlet ring. The wheel shall be firmly attached to the fan shaft with set screws and keys. The blower assembly shall be isolated from the fan structure with vibration isolators.

.3 Fan assemblies shall be statically and dynamically balanced for quiet operation. Provide slide out rails for servicing and maintenance of the fan.

.4 The fan motor shall be direct drive with VFD complete with shaft grounding, thermal overload protection and phase failure protection. Motors shall be premium efficiency.

.1 Motor & Motor Compartment: Motors shall be heavy duty ball bearing type. Motor mounting plate shall be constructed of heavy gauge galvanized steel and shall be designed to provide easy adjustment of belt tension. Blower motor shall be Open Drip Proof. Motors shall include shaft grounding.

.5 On units 16 tons or larger (nominal), the motor shall be T Frame and open drip proof. Overload protection and speed control is provided by the factory installed VFD and rooftop unit controller. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

2.4 EVAPORATOR COIL

.1 Evaporator Coils

.1 Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.

.2 Coils shall have interlaced circuitry and shall be standard capacity.

.3 Coils shall be hydrogen or helium leak tested.

.4 Coils shall be furnished with factory installed expansion valves.

2.5 REFRIGERATION SYSTEM

.1 Unit shall be factory charged with R-410A refrigerant.

.2 Compressors shall be scroll type with thermal overload protection and carry a 5-year non-prorated warranty, from the date of original equipment shipment from the factory.

.3 Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.

.4 Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

.5 Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.

.6 Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low-pressure sides and a factory installed liquid line filter driers.

.7 Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity and an on/off compressor on the lag refrigeration circuit.

.8 Unit shall be configured as an air-source heat pump. Each refrigeration circuit shall be equipped with a factory installed liquid line filter drier with check valve, reversing valve, accumulator, and expansion valves on both the indoor and outdoor coils. Reversing valve shall energize during the heat pump cooling mode of operation.

.9 Each refrigeration circuit shall be equipped with a liquid line sight glass.

.10 Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.

.11 The factory installed controls shall include a 3 minute off delay timer to prevent compressor short cycling. The controls shall also include an adjustable, 20 second delay timer for each additional capacity stage to prevent multiple capacity stages from starting simultaneously and adjustable compressor lock out.

2.6 CONDENSER

.1 Air cooled with vertical discharge, axial flow, direct drive fans.
.2 Heat pump outdoor coils shall have seamless copper tubes, mechanically bonded to aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil, designed for a minimum of 10°F refrigerant sub-cooling.
.3 The refrigeration circuit shall have both low and high pressure safety switches. Temperature sensors shall be provided for measuring suction and discharge temperature of the refrigerant.
.4 Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for compressor startup under low head pressure conditions. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start. Each circuit shall be dehydrated and factory charged with Refrigerant 410A and oil.
.5 Coils shall be hydrogen or helium leak tested.
.6 Condenser fans shall be VFD driven variable speed for condenser head pressure control. Factory provided and factory programmed VFDs shall continuously modulate the fan air flow to maintain head pressure at acceptable levels. Cooling operation shall be allowed down to 35°F with adjustable compressor lockout.

2.7 ELECTRIC HEATING

.1 Backup electric heating capacity shall be sized to meet heating leaving air temperature setpoint when heat pump heating is not in operation.

2.8 ECONOMIZER

.1 Unit shall be provided with an outdoor air economizer section. The economizer shall include outdoor, return, and exhaust air dampers. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream
.2 The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be opposed blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 4 cfm / square foot of damper area at 1” differential pressure per ASHRAE 90.1 Energy Standard.
.3 A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges.
.4 Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood, and relief dampers.

1.2 FILTERS

.1 Unit shall include 4-inch thick, pleated panel filters with an ASHRAE MERV rating of 13, upstream of the cooling coil. Unit shall also include 2-inch thick, pleated panel pre filters with an ASHRAE MERV rating of 8, upstream of the 4-inch standard filters.
.2 Unit shall include a clogged filter switch.
.3 Unit shall include a Magnehelic gauge mounted in the controls compartment.

2.9 ENERGY RECOVERY

.4 Unit shall contain a factory mounted and tested energy recovery wheel. The energy recovery wheel shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings. Frame shall slide out for service and removal from the cabinet.

.5 The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.

.6 The energy recovery cassette shall be an Underwriters Laboratories Recognized Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.

.7 Unit shall include 2-inch thick, pleated panel outside air and exhaust air filters with an ASHRAE MERV rating of 8, upstream of the wheels.

.8 Hinged service access doors shall allow access to the wheel.

.9 Polymer Energy Recovery Wheels

.1 Shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.

.2 All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive.

.3 Polymer Energy recovery wheel cassette shall carry a 5-year non-prorated warranty, from the date of original equipment shipment from the factory. The first 12 months from the date of equipment startup, or 18 months from the date of original equipment shipment from the factory, whichever is less, shall be covered under the standard RTU manufacturer limited parts warranty. The remaining period of the warranty shall be covered by manufacturer of energy recover wheel. The 5-year warranty applies to all parts and components of the cassette, with the exception of the motor, which shall carry an 18-month warranty. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided the manufacturer's written instructions for installation, operation and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts.

.4 Total energy recovery wheels shall be coated with silica gel desiccant permanently bonded by a process without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

2.10 ROOF CURB

.1 Curbs shall be seismically rated, fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit. Curb shall be minimum 3 ft high to accommodate connections to existing roof penetrations. Curb shall be high enough to maintain ESA clearance from roof to bottom of all electrical components

.2 Solid bottom curb shall be factory assembled and fully lined with curb rated 1 inch fiberglass insulation and include a wood nailer strip. All perforations are to be fully sealed by the installing contractor and is to be filled with Roxul style acoustic insulation provided by the contractor.

2.11 ELECTRICAL

.1 Unit shall have a 5kAIC SCCR.

.2 All electrical controls on the control board shall be mounted in an isolated, fully enclosed and insulated vestibule, completely separated from any combustion air, but accessible for servicing needs.

.3 Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.

.4 Unit shall be provided with a factory installed and field wired 115V, 20-amp GFI outlet in the unit control panel.

.5 Air-source heat pump shall include a defrost cycle to prevent frost accumulation on the outdoor coil during heat pump heating operation. Defrost cycle shall begin when outdoor coil temperature is below a fixed setpoint and have a fixed 10-minute run time, or end when the outdoor coil temperature is above a fixed setpoint. Defrost timer, with 30/60/90 minute selectable defrost cycle interval time, shall be factory installed in the controls compartment. During defrost cycle all compressors shall energize, reversing valve shall de-energize, and auxiliary heat shall energize.

.6 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

.7 Unit shall be provided with manual reset low temperature limit controls that must be field wired in the supply air ductwork, which shut off the unit when the discharge temperature reaches a field adjustable setpoint.

2.12 CONTROLS

.1 Field installed DDC controls by Division 25
- .1 Unit shall be provided with terminal block for field installation of DDC controls.
- .2 Isolation relays shall be factory installed.

.2 Safety Controls:
- .1 motor starter with adjustable overloads
- .2 main air-flow safety switch
- .3 high-temperature limit switch
- .4 non-fused disconnect

.3 Wiring and Electrical
- .1 The control circuit voltage shall be 24 volts.
- .2 A control transformer shall be provided.
- .3 Unit shall have standing 120 VAC power.
- .4 The control wiring shall be carried in wire channel or conduit.
- .5 Wiring in control enclosures shall be in accordance with the Electrical Code and local codes.
- .6 Motor starter shall be provided.
- .7 Starter shall be line voltage, definite purpose type.
- .8 Unit shall be complete with all items such as relays, starters, switches, safety controls, conduit and wire as required for proper operation.
- .9 All factory-mounted controls shall be factory prewired to the unit control panel.
- .10 Unit shall be supplied with:
  - .1 Single point electrical connection shall be supplied.
  - .2 Blower-on delay timer to pre-heat the heat-exchanger prior to energizing the main blower.
  - .3 Convenience outlet shall be provided on the control board with 120 VAC service.
  - .4 Freeze-stat shall be provided with adjustable dials for time and temperature settings to shut down the main blower in case of burner failure.
  - .5 Dirty filter airflow switch with LED indicator light on remote panel.
  - .6 Cabinet heater strip with thermostat.

2.13 PERFORMANCE

.1 As specified in the Mechanical Equipment Schedule Drawing.

3 EXECUTION

3.1 EXAMINATION

.1 Section 23 01 01 – General Requirements

.2 Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

.3 Verify that proper power supply is available.

3.2 INSTALLATION

.1 Install to manufacturer's instructions.
.2 Install to NFPA 90A.
.3 Mount units on factory built roof mounting curb and coordinate roof penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof structure with anchor bolts. Install roof mounting curb level.
.4 Install condensate drain, minimum connection size, with trap and direct to nearest roof.
.5 Install ducts to termination at top of roof curb. Remove roof decking only as required for passage of ducts; do not cut out decking under entire roof curb.
.6 Locate remote panels where indicated.
.7 Install economizer as per manufacturer's instructions.
.8 All unit power wiring shall enter unit cabinet at a single locations.
.9 Power wiring under Division 26.
.10 Control wiring under Division 25.

3.3 MANUFACTURER'S FIELD SERVICES

.2 Prepare and start systems to Section 20 01 01- General Requirements and 20 05 00 – Common Work Results.
.3 Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 81 43 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Air to water heat pump

1.4 SUBMITTALS FOR REVIEW

.1 Product Data: Provide typical catalogue of information including arrangements.
.2 Shop Drawings:
  .1 Indicate cross sections of cabinets, bracing and reinforcing, and typical elevations.
  .2 Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
  .3 Indicate mechanical and electrical service locations and requirements.,
.3 Manufacturer's Instructions: Indicate installation instructions and recommendations.
.4 Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
.5 Operation and Maintenance Data: Include manufacturer’s descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
.6 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.6 REGULATORY REQUIREMENTS

.1 All equipment and material to be furnished and installed on this Project shall be CSA or ETL listed, in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use on this Project.

2 PRODUCTS

2.1 HEAT PUMP

.1 Acceptable Manufacturers:
  .1 Aermec
  .2 Or acceptable equivalent
.2 Provide 40% glycol solution to air heat pumps as shown on plans, with capacities, model, type and characteristics as listed in the Schedule. Unit shall be AHRI rated and approved.
.3 Unit shall be suitable for outdoor installation.
.4 Units shall be shipped with an operating charge of R454B refrigerant.
.5 Construct unit casing, structural members and rails of G90 galvanized steel and galvanized steel channel. All structural members and rails shall be 10-gauge thickness; control boxes 15-gauge thickness and unit panels 17-gauge thickness. All exterior components shall be painted.
.6 Provide easily removable, separate access panels to the control centre and the compressor compartment and removable top panel and condenser fan deck assemblies.
.7 Provide overall "A" weighted sound pressure levels based on measurements taken 30 feet from the

side of the heat pump. Measurements taken at the control box, opposite to the control box end, or more than 30 feet from the side of the unit are unacceptable.

.8 The new structural roof platform and design is based on the dimension and weight as indicated in the equipment schedule. Contractor to include for any additional modification required for the deviation of from the proposed air cooled heat pump dimension and weight from the scheduled one.

.9 Construct fluid heat exchangers as shell and tube or brazed plate as denoted on the schedules. Stamped in accordance with ASME.

.10 For brazed plate evaporators, provide a fine mesh strainer installed in the hydraulic circuit upstream of the evaporator to protect the heat exchanger.

.11 Wrap evaporator heat exchanger with an electric heater cable and insulate to provide freeze protection to -29 deg. C. (-20 deg. F.) ambient air temperature. Provide drain and ventilation fittings.

.12 Construct air coils from seamless copper tubes mechanically expanded into aluminum fins with integral sub-cooling circuits or aluminum microchannel coils.

.13 Provide drain pans for outdoor coils to fully drain water during heating and defrost modes. Drains to be connected a single drain connection for connection to a roof drain. Drain pans must be heat traced by others.

.14 Fans shall be complete with variable speed for capacity and performance control.

.15 All compressors shall be mounted to the chassis to attenuate noise transmission/vibration. Other mounting arrangements will not be acceptable. Manufacturer shall provide full octave band sound power ratings with submittal drawings.

.16 Provide sealed hermetic, scroll type compressor with the following:

.1 Crankcase oil heater and suction strainer.

.2 Refrigerant gas cooled, high torque, hermetic induction type, two-pole motor, with inherent thermal protection on all three phases

.3 Mounted on rubber-in-shear vibration isolator pads.

.4 Refrigeration Circuit

.5 Provide each circuit with an electronic expansion valve, compressor suction and discharge service valves(optional), manual liquid line shutoff valve with charging connection, replaceable core filter drier, liquid line sight glass with moisture indicator, liquid solenoid valve, purge valves, relief valves and insulated suction line.

.6 Provide each circuit with two pressure transducers, one for the evaporator and one for the condenser. Output signal directly to the microprocessor control system. Calculated pressure readings are not permitted.

.7 Provide automatic head pressure control to permit satisfactory operation at ambient air temperatures down to or up to schedules values for heating and cooling operation.

.17 Provide centrally located field power connection, control interlock terminals and unit control system in a weatherproof enclosure.

.1 Provide key lock on panel access door to prevent unauthorized access.

.18 Provide the following power and starting components:

.1 Circuit breaker for each compressor

.2 Fusing for the control circuit

.3 Compressor starting contactors

.4 Solid state compressor sequence start timer

.5 Compressor overload protection in all three phases

.6 Unit power terminal block for field connection to a single power supply and control power transformer.

.7 Field wiring if single power supply is not a heat pump option.

.19 Provide microprocessor-based control system, electronic expansion valves and fuzzy logic control.

.20 Provide five (5) steps of fan control for each circuit.

.21 Provide 12-key keypad and digital display for access to temperatures, pressures, set points, operating states, schedules and alarm messages.

.22 Unit shall be BACnet compatible as defined by ANSI/ASHRAE Standard 135 for integration into building automation system.

.23 Control system shall provide the following:

.1 Phase loss, phase reversal with under and over voltage protection
.2 Motor protection for each compressor
.3 High condenser refrigerant pressure unloading for each circuit.
.4 High compressor discharge pressure cut-out for each circuit
.5 Freeze protection for each circuit
.6 Low evaporator refrigerant pressure unloading for each circuit
.7 Low evaporator refrigerant pressure cut-out for each circuit.
.8 Chilled water freeze protection
.9 Loss of chilled water flow
.10 Loss of refrigerant charge
.11 Evaporator or condenser pressure sensor failure
.12 Volts ratio sensor failure
.13 Leaving chilled water sensor failure
.14 Expansion valve failure

.24 Warranty
.1 One Year Warranty
.1 A one year warranty shall be provided for furnishing parts and labour for replacing any part of conditioners which becomes defective in normal operation from the date of Substantial completion.
.2 Mechanical Contractor shall be responsible for all costs incurred, not covered by manufacturer.
.2 Five Year Refrigeration Circuit Warranty
.1 Hermetically sealed motor compressor assembly and all components of the refrigerating circuit not readily separable therefrom shall be warranted to the Owner for use for five years after date of Substantial Completion.
.2 Warranty does not include any other parts of equipment such as filters, fans, fan motors, compressor overloads, protective devices, controls cabinet parts, electrical relays, capacitors or wiring.
.3 Repairs under this warranty will be repaired at the manufacturer's expense, provided the conditioner is delivered, without shipping damage, transportation prepaid to the factory or authorized repair station.
.4 After the first year, the Owner will be responsible for disconnection, crating, delivery, transportation, reinstallation, and reconnection costs.

.25 Include with each unit a set of fire rated flexible hoses for supply, return and drain as supplied by unit manufacturer. The hoses shall have an inner core of non-toxic synthetic polymer with an outer braided covering of stainless steel. Rubber hoses are not acceptable. Also provide two field mounted combination balancing shut-off ball valves with adjustable memory stops.

.26 Start Up: provide the services of a certified manufacturer's representative during start-up and Owner's instruction.

3 EXECUTION

3.1 GENERAL

.1 Locate unit or equipment upon arrival: level and make secure.
.2 Install according to piping layout. Provide for pipe movement during normal operation. Pipe drains and blow off connections to nearest drain.
.3 Maintain proper clearance around equipment to permit performance of service maintenance. Check final location with Consultant if different from that indicated prior to installation.
.4 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
.5 Refer to manufacturer's installation drawings. Check electrical service work with characteristics stamped on unit.
.6 Check that all openings for appurtenances and operating weight conform to shop drawings.

3.2 HEAT PUMP UNITS

.1 Install heat pump units where and as indicated on drawings.

.2 Make supply and return piping connections. Make all pipe connections to heat pumps using stainless steel flexible hoses as supplied by unit manufacturer. Ensure that installation of units provides for proper grade of condensate drain piping.

.3 Provide isolating and throttling valves at inlet and outlet to each coil.

.4 Provide deep seal trap at drain connection and pipe to drain.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

.1 Section 23 82 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

.1 Unit heaters.
.2 Cabinet unit heaters.

1.4 SUBMITTALS FOR REVIEW

.1 Product Data: Provide typical catalogue of information including arrangements.
.2 Shop Drawings:
  .1 Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
  .2 Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
  .3 Indicate mechanical and electrical service locations and requirements.,
.3 Manufacturer's Instructions: Indicate installation instructions and recommendations.
.4 Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
.5 Operation and Maintenance Data: Include manufacturer’s descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
.6 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.6 REGULATORY REQUIREMENTS

.1 All equipment and material to be furnished and installed on this Project shall be CSA or ETL listed, in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use on this Project.

2 PRODUCTS

2.1 UNIT HEATERS

.1 Manufacturers:
  .1 Sigma
  .2 Sterling
  .3 Trane
  .4 Rosemex
  .5 Or approved alternate
.2 Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
.3 Casing: 20-gauge (1.2 mm) steel with threaded pipe connections for hanger rods.
.4 Finish: Factory applied baked primer coat.
.5 Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

.6 Air Outlet: Adjustable pattern diffuser on projection models and two-way louvres on horizontal throw models.
.7 Motor: permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models. Refer to Section 20 05 00.
.8 Control: Variable Speed Control, Manual starter with pilot light includes overload matching motor, up to 277vac, 16A continuous current rating, UL, CSA
.9 Capacity: As scheduled.

2.2 CABINET UNIT HEATERS

.1 Manufacturers:
  .1 Sigma
  .2 Sterling
  .3 Trane
  .4 Rosemex
.2 Coils: 1/2" (13mm) evenly spaced rippled aluminum fins mechanically bonded to copper tubes, designed for 1380 kPa and 104°C (220°F).
.3 Cabinet: 16-gauge (1.5 mm) steel with exposed corners and edges rounded, easily removed panels, glass fibre insulation and integral air outlet.
.4 Finish: Factory applied baked enamel coat on all surfaces of enclosure or cabinet. Colour as selected by the Architect.
.5 Fans: Centrifugal forward-curved double-width double-inlet (DWDI) wheels, statically and dynamically balanced, direct driven.
.6 Motor: 3-speed permanent split capacitor with internal automatic re-set overload protection and sleeve bearings, resiliently mounted.
.7 Control: 3-speed plus off fan switch, factory wired, located in cabinet.
.8 Filter: easily removed 1” (25 mm) thick glass fibre throw-away permanent washable type, located to filter air before coil.
.9 Capacity: As Scheduled.

3 EXECUTION

3.1 INSTALLATION

.1 Install to manufacturer's instructions.
.2 Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.
.3 Protection: Provide finished cabinet units with protective covers during balance of construction.
.4 Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
.5 Cabinet Unit Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.
.6 Hydronic Units: Provide shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing for cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.

3.2 CLEANING

.1 After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
.2 touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials provided by manufacturer (VOC content not to exceed 250 g/L)
.3 Install new filters.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01 applies to and governs all work of Division 21, 22 and 23.

1.2 SECTION INCLUDES

.1 Radiant floor heating systems and control strategies, using cross-linked polyethylene (PEX) tubing and appropriate fittings.

1.3 REFERENCES

.1 General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

.2 Certified to ASTM International by NSF:
- .1 ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing.
- .2 ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot-and Cold-Water Distribution Systems.

.3 Certified to ASTM International, UL, NFPA and ULC by Intertek:
- .1 ASTM E84, Standard Test Method for Surface Burning Characteristics of Test Materials.
- .2 ASTM E119, UL 263 and NFPA 251 Fire Tests of Building Construction and Materials.
- .3 CAN/ULC S101-04, Standard Test Methods for Fire Tests of Building Construction and Materials.

.4 Certified to Canadian Standards Association (CSA) by NSF:
- .1 CAN/CSA B137.5 Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications.

.5 Certified to International Code Council (ICC) by NSF:
- .1 International Mechanical Code (IMC)
- .2 International Building Code (IBC)

.6 Certified to International Association of Plumbing and Mechanical Officials (IAPMO) by NSF:
- .1 Uniform Mechanical Code (UMC)

.7 German Institute for Standards (Deutsches Institut fur Normung e.V., DIN):
- .1 DIN 4726 Pipelines of Plastic Materials Used in Warm Water Floor Heating Systems; General Requirements

.8 International Association of Plumbing and Mechanical Officials (IAPMO):
- .1 Certificate of Listing

.9 National Sanitary Foundation (NSF) International:
- .1 NSF - PW (Potable Water)
- .2 NSF - RFH (Radiant Floor Heating)
- .3 NSF CL - TD and CL - R (as specified in NSF Protocol P - 171)

.10 Plastics Pipe Institute (PPI)
- .1 Technical Report TR - 3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
- .2 Technical Report TR - 4 Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Piping and Fitting Compounds

.11 Watts Radiant
- .1 RadiantPEX, RadiantPEX+, and RadiantPEX-AL Installation Manual
- .2 RadiantWorks Professional Software

1.4 SYSTEM DESCRIPTION

.1 Design Requirements: Cross-linked Polyethylene Tubing (PEX): Standard Grade hydrostatic pressure ratings from Plastics Pipe Institute in accordance with TR-3 as listed in TR-4. The following three

standard-grade hydrostatic ratings are required:
.1 200 degrees F (93 degrees C) at 80 psi (551 kPa).
.2 180 degrees F (82 degrees C) at 100 psi (689 kPa).
.3 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa).

.2 Performance requirements: Provide Hydronic system that is manufactured, fabricated and installed to comply with regulatory agencies and authorities with jurisdiction, and maintain performance criteria stated by the tubing manufacturer without defects, damage, or failure.

.3 Cross-linked Polyethylene Tubing (PEX):
.1 Show compliance with ASTM F877
.2 Show compliance with DIN 4726 regarding oxygen diffusion concerns where applicable.
.3 Show compliance with NFPA 90A requirements of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 through certification listings with Intertek.
.4 Show compliance with ASTM E119, UL 263, NFPA 251, and CAN/ULC S101 through certification listings with Intertek:
.1 Intertek Design No. WR/WA 60-01: 1 hour wood or steel stud/gypsum wallboard wall assembly.
.2 Intertek Design No. WR/FCA 60-01: 1 hour wood frame floor/ceiling assembly
.3 Intertek Design No. WR/FCA 120-01: 2 hour concrete floor/ceiling assembly

1.5 SUBMITTALS FOR REVIEW

.1 Section 20 01 01: Procedures for submittals.
.2 Product Data: Submit manufacturer's product submittal data and installation instructions for each product.
.3 Shop Drawings:
.1 Provide engineering analysis using manufacturer's proprietary software.
.2 Provide installation drawings indicating tubing layout, manifold locations, zoning requirements, and manifold schedules with details required for installation of the system.
.3 Provide mechanical schematic indicating heat source, mechanical piping and accessories from heat source to manifolds, circulators, water tempering, and zone controls. Indicate supply water temperatures and flow rates to manifolds.
.4 Samples: Submit selection and verification samples of primary materials.

1.6 SUBMITTALS FOR INFORMATION

.1 Provide manufacturer's detailed instructions for site preparation and product installation.
.2 Provide manufacturers electrical power requirements and heat output in watts delivered to the structure.
.3 Provide documentation indicating the installer is trained to install the manufacturer's products, as needed.

1.7 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 20 01 01: Submittals for project closeout.
.2 Project Record Documents: Final as-built tubing layout drawing
.3 Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
.4 Manufacturer's field reports as specified in this document
.5 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer.

1.8 QUALITY ASSURANCE

.1 Materials shall be from a single manufacturer to ensure consistent quality and compatibility.
.2 Manufacturer Qualifications:
.1 Manufacturer shall have a minimum of ten years experience in similar systems.
.2 Manufacturer shall provide products of consistent quality in appearance and physical properties.

.3 Manufacturer shall use the highest quality products in the production of systems and components referenced in this document.

.3 Installer Qualifications:

.1 Use and installer with demonstrated experience on projects of similar size and complexity and/or documentation proving successful completion of familiarization training hosted/approved in writing by the system manufacturer.

.2 Electrical rough-in and connections shall be done by a licensed electrician.

.4 Certifications: Provide letters of certification as follows:

.1 Installer employs skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trade's person.

.2 test reports from recognized testing laboratories.

1.9 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

.2 Radiant system shall comply with the following requirements:

.1 International Code Council (ICC):

.1 International Mechanical Code (IMC)

.2 International Building Code (IBC)

.3 ICC Evaluation Service (ES) Evaluation Report No. ESR 1155

.2 International Association of Plumbing and Mechanical Officials (IAPMO):

.1 Uniform Mechanical Code (UMC)

1.10 PRE-INSTALLATION MEETINGS

.1 Verify project requirements, substrate conditions, excavation conditions, system performance requirements, coverings, manufacturer's installation instructions, and warranty requirements.

.2 Review project construction timeline to ensure compliance or discuss modifications as required.

.3 Coordinate with other trade representatives to verify areas of responsibility.

.4 Establish the frequency (during construction phase of the project) the engineer intends for site visits and inspections by the manufacturer's representative.

1.11 DELIVERY, STORAGE, AND HANDLING

.1 General: Comply with Division 20 01 01

.2 Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

.3 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

.4 Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer:

.1 Store tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.

.2 Do not expose tubing to direct sunlight for more than 24 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight.

1.12 ENVIRONMENTAL CONDITIONS

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

.2 Morter-set Systems: Mortar shall cure for 25 days (or time specified by mortar manufacturer) prior to starting heating systems.

1.13 WARRANTY

.1 Refer to Division 20 01 01 project warranty provisions.

.2 Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized

company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

.1 Warranty covers the repair or replacement of any tubing or fittings proven defective.
.2 Warranty may transfer to subsequent owners.
.3 Warranty Period for Tubing is 25-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.
.4 Warranty Period for Manifolds and Fittings is 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.
.5 Warranty period for Controls and Electrical components is a 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.

1.14 SYSTEM START-UP

.1 Do not start the system for a minimum of 25 days or as specified by mortar, concrete and/or covering manufacturer as applicable.
.2 Verify all electrical components are installed per local and National Electrical Code (NEC) prior to start-up.

1.15 OWNER'S INSTRUCTION

.1 Instruct Owner about operation and maintenance of installed system.
.2 Provide Owner with manufacturer's installation instructions for installed components within the system.
.3 Provide Owner with all operating instructions/documents for sensors and controls.
.4 Provide Owner with copies of any detailed layout drawings and photos of installed product before coverings are installed.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Acceptable Manufacturers:
  .1 Uponor Wirsbo
  .2 Rehau (Klimatrol Environmental Systems Ltd.)
  .3 AquaHeat
  .4 WattsRadiant, Inc.
  .5 Heat Link
  .6 Or approved equivalent

2.2 PRODUCT CHARACTERISTICS

.1 Material:
  .1 Cross-linked polyethylene (PEX)
  .2 Manufactured by PEX-a Method.
.2 Material Standard:
  .1 Manufactured in accordance with ASTM F876 and ASTM F877
  .2 Tested for compliance by an independent third-party agency.
.3 Pressure Ratings:
  .1 Standard Grade hydrostatic design
  .2 Pressure ratings as issued by the Plastics Pipe Institute (PPI), a division of the Society of the Plastics Industry (SPI).
.4 Temperature/Pressure Ratings: shall be capable of withstanding temperatures of:
  .1 73.4°F (23°C) at 160 psi (1.10 MPa)
  .2 180°F (82.2°C) at 100 psi (0.69 MPa)
  .3 200°F (93.3°C) at 80 psi (0.55 MPa).
.5 Minimum Bend Radius (Cold Bending):
  .1 No less than six times the outside diameter.
  .2 Use the tubing manufacturer's bend supports if radius is less than stated.

.6 Nominal Inside Diameter: Provide tubing with nominal inside diameter in accordance with ASTM F876, as indicated:
- .1 ½ inch (12.7 mm)
- .2 ¾ inch (19.05 mm)
- .3 1 inch (25.4 mm)

2.3 MANIFOLDS AND FITTINGS

.1 Manifolds
- .1 Manifolds shall provide individual flow control for each loop of the manifold through valve actuators available from the manifold supplier. Each loop shall have a in-floor temperature sensor and room space thermostat to control the valve actuator. Manifold tags shall identify area served and loop number.
- .2 Manifolds shall be manufactured of brass or stainless steel.
- .3 Manifolds shall feature manual flow balancing capability within the manifold body for balancing unequal loop lengths across the manifold. Balance valves shall not be ball valves.
- .4 Each manifold shall be provided with automatic air vents.
- .5 Balancing:
  - .1 Design individual loop lengths across the manifold with 10% of each other in length.
  - .2 Install supply and return piping to the manifold in a reverse-return configuration to ensure self-balancing.
  - .3 Where the supply and return piping is in direct-return configuration, use manifolds with balancing valves or balance flow setters on the return leg of each manifold to the mains.

.2 Manifold Mounting Cabinets
- .1 Manifold box shall be designed to be recessed into a 6" (152 mm) stud wall and be of sufficient size to allow BMS controls and manifold zone valves to be installed within the cabinet.
- .2 Manifold box is constructed of powder-coated sheet metal, providing increased resistance to corrosion and job-site abuse.

.3 Fittings
- .1 For system compatibility, use fittings offered by the tubing manufacturer.
  - .1 The fitting assembly shall comply with ASTM F877 and CAN/CSA B137.5 requirements.
  - .2 Fittings shall be designed to work with either ASTM F1807 CrimpRings or ASTM F2098 CinchClamps or a Compression ferrule, and are designed to be used with ASTM F876 (SDR-9) rated PEX tubing.

2.4 ACCESSORIES

.1 Utilize manufacturer’s system installation accessories including: nylon cable binders, pipe sleeves, protective sleeving, pipe cutters, pipe uncoilers and other installation tools and aids.pipe ties.

2.5 CONTROLS

.1 A complete radiant floor heating control system shall be provided by the radiant floor heating system manufacturer. Control panel shall be factory-built, factory-tested and factory-warranted for 2 years when a panel registration card is returned by the installing contractor.

.2 The control systems shall allow for the following capabilities:
- .1 Manifold Multi zone activation
- .2 Zone air and slab thermostat input
- .3 System pump and boiler activation

.3 A zone control board shall be provided for each manifold as indicated on mechanical system schematics.

3 EXECUTION

3.1 EXAMINATION

.1 Site Verification of Conditions:
  .1 Verify that site conditions are acceptable for installation of the system. Refer to manufacturer's installation manual for information.
  .2 Do not proceed with installation of the system until unacceptable conditions are corrected.

3.2 FIELD QUALITY CONTROL AND TESTING

.1 Site tests:
  .1 To ensure system integrity, pressure test the system before covering tubing in concrete or when other trades are working in the vicinity of the tubing.
  .2 Test all electrical controls in accordance with respective installation manuals.
  .3 System shall be checked after 3 years of operation and every year thereafter. System shall be checked for pH levels to ensure that it is operating within suggested guidelines.

3.3 SYSTEM ADJUSTING

.1 Balancing Across Manifold: Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.
.2 Balancing between manifolds is accomplished with a flow control device installed on the return piping leg from each manifold when direct return piping is used for the supply and return mains or the circuits deviate by more than 10%.

3.4 CLEANING

.1 Remove temporary coverings and protection of adjacent work areas.
.2 Repair or replace damaged installed products.
.3 Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
.4 Remove construction debris from project site and legally dispose of debris.

3.5 DEMONSTRATION

.1 Demonstrate operation of system to Owner or Owner's personnel.
.2 Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

3.6 PROTECTION

.1 Protect installed work from damage caused by subsequent construction activity on the site. Provide Owner with copy of photos and drawings of product locations to assist.

3.7 UNDERFLOOR RADIANT HEATING

.1 Hydronic radiant heat tubing loops shall be installed in accordance with the supplier/manufacturer’s design and recommendations and details shown on drawings.
.2 Mechanical contractor to supply any installation materials such as ties or mesh required for installation of the tubing.
.3 All fittings to be accessible for maintenance. Tubing loops to be installed without splice, from the point at which the tubing enters the panel to the point at which it exits the panel.
.4 Installation shall follow the shop drawings to tubing layout, tubing spacing, manifold configuration, manifold locations and controls.
.5 System Manufacturer/supplier shall include for supervision of laying of pipe, pressure test and concrete pour and shall set-up controls and commission the systems to ensure full and proper operation.
.6 The tubing system shall be pressurized with water or air, in accordance with applicable codes and manufacturer’s instructions, or to a pressure of 60 psig 24 hours prior to encasement in the radial panel. The tubing shall remain at this pressure during the panel installation, and for a minimum of 24 hours thereafter to ensure system integrity. This section assumes all liabilities for suitable safety precautions and testing, including the use of compressed air, when applicable

.7 At start up time this Section shall follow the supplier/manufacturer's recommendations for system water and temperature balancing, record balance settings at each manifold location, and deliver to the Consultant a complete record of these setting include in the operation and maintenance manuals

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 20 01 01.
.2 The Contractor shall participate in integrated testing procedures and provide assistance to the Integrated Testing Coordinator, for the successful completion of testing mechanical systems under Divisions 21, 22, 23 and 25 with fire protection and life safety functions in accordance with CAN/ULC-S1001 Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.2 COMMON WORK RESULTS

.1 Section 20 05 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 REFERENCE STANDARDS

.1 Provide all work in accordance with requirements of Regulatory Agencies and conform to:
  .1 Local and district by-laws, regulations and published engineering standards.
  .2 Ontario Building Code (OBC) as amended,
  .3 Ontario Fire Code (OFC) as amended,
  .4 Ontario Electrical Safety Code (OESC).
  .5 Regulations for Construction Projects under The Occupational Health and Safety Act.
.2 Conform to following National Research Council Canada publications:
  .1 National Building Code of Canada (NBC) and Supplements to National Building Code of Canada
  .2 National Fire Code of Canada (NFC).
.3 Conform to following National Fire Protection Association publications:
  .1 NFPA 70 National Electrical Code (NEC)

1.4 FIELD QUALITY CONTROL

.1 All work, materials, and equipment shall comply with the rules and regulations of applicable local, provincial and federal codes and standards.
.2 Continually monitor the field installation for code compliance and quality of workmanship.

1.5 QUALIFICATIONS

.1 Motor manufacturer: Company specializing in manufacture of electric motors, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
.2 Firestop Sealant Manufacturer: Company specializing in manufacture of sealants with minimum three years documented product development, testing, and manufacturing experience.
.3 Firestop components and assemblies shall be ULC listed and tested in accordance with ULC S115 Standard Method of Fire Test for Firestop Systems.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with Section 20 01 01, for the following items:
  .1 firestopping compounds and applications schedule
  .2 access doors

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Transport, handle, store, and protect products. Refer to Division 1 requirements as well.
.2 Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.8 WASTE MANAGEMENT & DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 1, and with the Project Co's Waste Reduction Workplan.
.2 Place materials defined as hazardous or toxic waste in designated containers.
.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

2 PRODUCTS

2.1 ELECTRICAL COMPONENTS AND WIRING

.1 Conform to requirements of Division 26 for all wiring, conduits and raceways, boxes, and cable trays included in Division 25.
.2 All pre-wired equipment provided by Sections under Division 25 shall conform to requirements of Division 26. Ensure that all pre-wired electrical equipment is CSA approved. Arrange and pay for special approval where this is not possible.
.3 Communication and control wiring and power supplies specified as conforming to NEC Class 1, Class 2 and Class 3 wiring practices must also conform to OESC Section 16 requirements.

2.2 COMMUNICATION AND CONTROL WIRING

.1 General:
  .1 Provide copper wiring, plenum cable, and raceways as specified in the applicable Sections of Division 26 unless otherwise noted herein.
  .2 All insulated wire to be copper conductors, ULC labeled for 90°C minimum service.
.2 Wire Sizing and Insulation
  .1 Wiring shall comply with minimum wire size and insulation based on services listed below:

Service	Minimum Gage/Type	Insulation Class
AC 24V Power	12 Ga Solid	600 Volt
DC 24V Power	10 Ga Solid	600 Volt
Class 1	14 Ga Stranded	600 Volt
Class 2	18 Ga Stranded	300 Volt
Class 3	18 Ga Stranded	300 Volt

  .2 Provide plenum-rated cable when open cable is permitted in supply or return air plenum.
.3 Power Wiring:
  .1 115V power circuit wiring above 100 feet distance shall use minimum 10 gage.
  .2 24V control power wiring above 200 feet distance shall use minimum 12 gage.
.4 Control Wiring:
  .1 Digital Input/Output wiring shall use Class 2 twisted pair, insulated.
  .2 Analog inputs shall use Class 2 twisted shielded pair, insulated and jacketed and require a grounded shield.
  .3 Actuators with tri-state control shall use Class 3 conductor with same characteristics
.5 Communication Wiring
  .1 Ethernet Cable shall be minimum CAT5e and as required for system components.
  .2 Secondary level network shall be 24 gage, TSP, low capacitance cable
.6 Approved Cable Manufacturers: Wiring from the following manufacturers which meet the above criteria shall be acceptable:
  .1 Anixter
  .2 Belden
  .3 Cerco
  .4 Or approved equivalent

2.3 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.
.2 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 MILSTD 810C for shock and vibration.

.2 Line voltage units shall be ULC recognized and CSA approved.

.3 Power line filtering: 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.

2.4 FIRESTOPPING COMPOUNDS

.1 Manufacturer:

.1 3M products indicated.
.2 Dow Corning
.3 John Manville
.4 Hilti Firestop Systems
.5 Or approved equivalent

.2 Fire Rated Sealants: intumescent material, synthetic elastomers, capable of expanding up to 8 to 10 times when exposed to temperatures of 250°F (121°C) or higher. ULC listed and labelled.

2.5 ADHESIVES, SEALANTS, PAINTS AND COATINGS

.1 Adhesives, Sealants, Paints and Coatings: Use only low VOC emitting materials meeting following criteria;

.1 Paint for Mechanical Identification: maximum VOC emission of 250g/L
.2 Touch-Up Paint: maximum VOC emission of 250g/L
.3 Zinc-Rich Primer: maximum VOC emission of 250g/L
.4 Adhesives for Mechanical Identification: maximum VOC emission of 70g/L
.5 Sealants for service penetrations: maximum VOC emission of 650g/L clear and 350 g/L pigmented
.6 Sealants for Firestopping: max. VOC emission of 650g/L clear and 350 g/L pigmented
.7 Acrylic Sealant for supports and anchors: maximum VOC emission of 250g/L
.8 Insulation Vapour Barrier Lap Adhesive: maximum VOC emission of 80g/L
.9 Insulation Joint Sealer: maximum VOC emission of 250g/L
.10 Insulation Vapour Barrier Mastic: maximum VOC emission of 400g/L
.11 Flame Retardent Adhesive: maximum VOC emission of 650g/L clear and 350 g/L pigmented

2.6 ACCESS DOORS

.1 Manufacturers:

.1 Acudoor
.2 CEB
.3 MIFAB
.4 Cendrex Contour
.5 Or approved equivalent

.2 Standard Universal Flush

.1 Material: Up to 16" x 16" (400x400) 16 Gauge mounting frame, over 16" x 16" (400x400) 14-gauge door, 16 gauge mounting frame.
.2 Hinge: Continuous, concealed.
.3 Latch: Stainless steel screwdriver operated cam latch
.4 Finish: Steel: 5-stage iron phosphate preparation with prime coat of white, Alkyd Baking Enamel

.5 Manufacturer Model: Acudoor UF-5000 General, Acudoor DW-5040 Drywall Walls, Acudoor BP58 Drywall Ceilings to match ceiling thickness, Acudoor DW-5040 Existing Drywall

.3 Recessed Access Door
- .1 Material: Steel or stainless steel, 22-gauge door, 22 gauge mounting frame. Door-recessed 5/8"
- .2 Hinge: Continuous, concealed.
- .3 Latch: Stainless steel screwdriver operated cam latch
- .4 Finish: Satin coat steel
- .5 Manufacturers Model: Acudoor DW-5015

.4 Fire Rated
- .1 Access doors in fire separations or fire rated assemblies: ULC labelled. Refer to Architectural drawings for ratings of fire separations and assemblies. Minimum 20-gauge door, 16 gauge mounting frame.
- .2 Hinge: Continuous, concealed.
- .3 Latch: Stainless steel screwdriver operated cam latch
- .4 Finish: Steel: 5-stage iron phosphate preparation with prime coat of white, Alkyd Baking Enamel
- .5 Manufacturers Model: Acudoor FW-5050/FB-5060 to match fire separation.

2.7 FLASHINGS AND CONTERFLASHINGS

.1 Thaler or equivalent mechanical/electrical flashings as recommended for specific purpose.
.2 Stainless steel flashing sleeve, integral deck flange and EPDM seal.

2.8 NAMEPLATES

.1 Provide laminated plastic plates with black face and white centre of minimum size 3-1/2" x 1-1/2" x 3/32" (90 x 40 x 2 mm) nominal thickness, engraved with 1/4" (6 mm) high lettering. Use 1" (25 mm) lettering for major equipment.
.2 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.
.3 Identify equipment type and number and service of areas or zone of building served.
.4 For each item of equipment supplied and/or installed under this Division which may be started automatically or remotely, provide a red lamacoid plate, 2-1/2" x 9" (60 x 230 mm), reading:

"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME."

2.9 TAGS

.1 Tags shall either be plastic or metal.
.2 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 1-1/2" (40 mm) diameter.
.3 Metal Tags: Brass, aluminum or stainless steel with stamped letters; tag size minimum 1-1/2" (40 mm) diameter with smooth edges.
.4 Charts: Typewritten letter size list in anodized aluminum frame.

3 EXECUTION

3.1 INSPECTION

.1 Inspect installed work of other trades and verify that such work is complete to point where work under this Division may properly commence.
.2 Verify that work of this Division may be executed in accordance with pertinent codes and regulations, specifications, drawings, and referenced standards.
.3 Review drawings and verify dimensions at the site. Report discrepancies immediately to Consultant before proceeding with any construction work or shop drawings.

3.2 PREPARATION

.1 Existing services and equipment shall be relocated or removed to suit new construction and renovation work.
.2 Services that are no longer required shall be removed or cut back and capped to the satisfaction of Consultant.
.3 Obtain written authorization from Consultant for renovation work that is not specifically indicated.
.4 Where modifications or connections to existing systems require shutdown of the system. Submit a request for system shutdown describing the system or part to be shutdown, the duration of the shutdown, the work planned and steps to be taken to reinstate the system to full operation. The request shall be submitted in the format stipulated by the Owner.
.5 All work required to prepare systems for shutdown and/or re-instatement, such as draining, chemical treatments, and re-filling shall be included in this Guaranteed Price.

3.3 ELECTRICAL COMPONENTS AND WIRING

.1 Coordinate all wiring requirements with other Divisions. Line voltage wiring from power distribution panels to starters and from starters to motors will be provided under Division 26. All other field wiring for equipment shall be included under Division 25.

3.4 PROTECTION

.1 Protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under this Division.
.2 Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.
.3 All existing air intake and exhaust openings that may be affected by dust and/or debris from the construction work of this Division shall be fitted with appropriate filter media to protect against entry of dust and/or debris into the building and its air distribution systems. Filters shall be closely monitored and replaced when necessary. Replace existing filters that become contaminated with dust and/or debris from construction work with new filters.
.4 In the event that dust and debris from construction work does penetrate the building and/or its air distribution systems, be responsible for cleaning the affected areas and/or systems.
.5 Temporary filters shall be removed on completion of the construction works.

3.5 CUTTING AND PATCHING

.1 Include cutting and patching as required in execution of work under respective Sections of this Division.
.2 Holes through the structure will not be permitted without written approval of the Consultant. Any and all openings required through the completed structure must be clearly and accurately shown on a copy of the relevant structural drawing(s). Exact locations, elevations and size of the proposed opening must be identified well in advance of the need for the work.
.3 All sleeved or formed openings through the structure must be shown on sleeving drawings and must be approved by the Structural Consultant prior to construction.
.4 Conduct exploratory work including x-ray of the existing structure, shall mark the location of embedded reinforcements, anchors, conduits and piping on exposed surfaces of adjacent floors and/or walls and shall pay all associated costs.
.5 Reinforcing shall not be cut or modified without prior approval of the Structural Consultant. Should reinforcement be cut without such prior approval, the cost of any additional reinforcement deemed necessary by the Structural Consultant shall be the responsibility of this Trade.
.6 Alternative imaging techniques are subject to the approval of the Structural Consultant.
.7 Ensure that cutting and patching of roofs and reinforced concrete structures is executed by specialists familiar with the materials affected, and is performed in a manner to neither damage nor endanger the work. Coordinate and supervise such cutting and patching.
.8 Maintain the integrity of fire rated assemblies where they are pierced by ducts and pipes.
.9 Make good surfaces affected by this work and repair finish to satisfaction of Consultant. Finish painting, where required, will be provided under Division 9.

.10 Stop work immediately upon discovery of any hazardous material and report discovery to the Owner and Consultant. Obtain instruction prior to proceeding with the work.

3.6 SEALANTS & CAULKING

.1 Fill voids around pipes:
  .1 Where sleeves pass through non-fire rated walls or floors, caulk space between pipe and sleeve with fibreglass. Seal space at each end with waterproof, fire retardant, non-hardening mastic.
  .2 Ensure no contact between copper tube or pipe and ferrous sleeve.
  .3 Fill future-use sleeves with easily removable filler.
  .4 Coat exposed exterior surfaces or ferrous sleeves with heavy application of zinc rich paint (VOC content not to exceed 250 g/L).
.2 Temporarily plug all openings during construction.

3.7 FIRESTOPPING

.1 All openings in fire separations and fire rated assemblies for service penetrations shall be protected with ULC listed service penetration firestop systems (SP).
.2 The service penetration firestop system shall have F and FT ratings equal to or greater than ratings specified by the Architect for the fire separation (F) and firewall (FT) joint firestop systems (JF).
.3 All components employed in the service penetration firestop system shall conform to the ULC listing.
.4 Prepare and submit a schedule of service penetration firestop systems to be employed indicating the ULC listing designation, services involved, location of opening through fire separation and the components of the fire separation assembly.
.5 Refer to architectural drawings for ratings of fire separations and assemblies.

3.8 SUPPORT AND ATTACHMENT

.1 Support and attach raceways and equipment from load bearing structures such as beams, joists, reinforced concrete slabs and concrete block walls.
.2 Do not support from or attach to steel roof deck and/or wall or ceiling finishes.

3.9 PAINTING

.1 Repair minor damage to finish of equipment with standard factory applied baked enamel finish under the appropriate Sections of this division. Replace entirely, items suffering major damage to finish if too extensive to be repaired in the opinion of the Consultant.
.2 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.

3.10 FLASHINGS

.1 Provide all flashing at each point where piping passes through the roof.
.2 Coordinate this work with the roofing Trades to ensure a satisfactory installation and to avoid delays.

3.11 DISSIMILAR METALS

.1 Separate dissimilar metals in order to prevent galvanic corrosion.
.2 Provide gaskets or shims of approved materials to avoid electrolytic action.
.3 Use dielectric unions and/or flanges where piping of dissimilar metals are connected.

3.12 GUARDS

.1 Provide OSHA compliant guards for exposed drives as follows:
  .1 expanded metal screen (both sides) welded to 1" (25 mm) steel angle frame.
  .2 18 ga. 1" (25 mm) thick galvanized sheet metal tops and bottoms.
  .3 removable sides for servicing.
  .4 1-1/2" (40 mm) dia. holes on both shaft centres for insertion of tachometer.

.2 Provide means to permit lubrication and use of test instruments with guards in place.
.3 Install belt guards to permit movement of motors for adjusting belt tension.
.4 For flexible couplings, provide removable, "U" shaped, 12 ga. 1/10" (2.7 mm) thick galvanized frame and 18 ga. 1/25" (1.2 mm) thick expanded mesh face.

3.13 FIELD QUALITY CONTROL

.1 Temporary and Trial Usage
  .1 Allow the Owner the privilege of temporary and trial usage of installed equipment, as soon as work is complete, for a period of time required to conduct a thorough test.
  .2 Do not construe such usage as evidence of acceptance of work by Owner.
  .3 Repair damage to work tested, resulting from such trial usage, by this Trade at no cost to the Owner.
.2 Systems Verification:
  .1 Verify the correct installation and proper operation of equipment and systems installed. Adjust and balance each system as necessary to achieve optimum operation of each system.
  .2 Co-operate with the TAB agency as follows:
    .1 provide assistance when and as requested,
    .2 co-ordinate completion of work systematically to permit orderly verification and adherence to schedules,
    .3 provide additional necessary flow balancing devices as directed by agency,
.3 Notify TAB Agency of tests being conducted.

3.14 MANUFACTURER'S NAMEPLATES

.1 Provide metal nameplates on each piece of equipment, mechanically fastened with raised or recessed letters.
.2 Include registration plates, Underwriters' Laboratories and CSA approval, as required by respective agency and as specified. Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors, all factory supplied.
.3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

3.15 INSTALLATION OF GAUGES AND THERMOMETERS

.1 Install to manufacturer's instructions.
.2 Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
.3 Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
.4 Locate test plugs adjacent thermometers and thermometer sockets.

3.16 EQUIPMENT BASES AND CURBS

.1 Supply and erect structural work required for installation of equipment, cabinets, enclosures and panels.
.2 Build 4" (100 mm) high concrete curbs around all openings through mechanical room floors. Ensure joint between curb and floor is watertight and maintains integrity of floor membrane where applicable.
.3 Build concrete bases 6" (150 mm) high, providing all necessary inserts, anchor bolts and other fasteners required, for floor mounted tanks, compressors, etc. Make concrete bases 2" (50 mm) larger all around than the base of the supported equipment and trowel finish to a neat smooth finish. Anchor equipment to pads using 8" (200 mm) cast-in-place anchor bolts. Ensure concrete supplied under this Division is 2500 psi (17 MPa) compressive strength after 28 days. Coordinate with structural

3.17 FLOW DIAGRAMS AND DIRECTORIES

.1 Provide Consultant with six identification flow diagrams of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valves.
.2 Install where agreed with the Owner, one copy of each flow diagram and valve schedule mounted in

glazed frame. Provide one copy of each in Operation and Maintenance Manual.

3.18 INSTALLATION OF ACCESS DOORS

.1 Supply access doors for access to equipment requiring service, lubrication or adjustment and all concealed valves, cleanouts, trap primers, control and volume dampers, and other such equipment.
.2 Turn over access doors to the appropriate trade for installation under other Sections.
.3 Refer to architectural drawings for ratings of fire separations and assemblies. install fire rated access doors in fire rated partitions, walls, and ceilings.
.4 Access doors in ceilings shall be minimum 24" x 24" (600mm x 600mm), unless otherwise approved by the Consultant.
.5 Provide concealed access doors in GWB ceilings and coordinate in-fill with general trades.

3.19 INSTALLATION PRACTICES

.1 BMS Wiring
  .1 All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Trade unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
  .2 All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
  .3 Class 2 Wiring
    .1 All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
    .2 Class 2 wiring in concealed accessible locations shall be FT-6 plenum rated.
    .3 Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
  .4 Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
  .5 Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
.2 BMS Line Voltage Power Source
  .1 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided under Division 26.
  .2 Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
  .3 DDC terminal unit controllers may use AC power from motor power circuits.
.3 BMS Raceway
  .1 All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
  .2 Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
  .3 All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
  .4 Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
.4 Penetrations
  .1 Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
  .2 All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
  .3 All wiring passing through penetrations, including walls shall be in conduit or enclosed

raceway.

.4 Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

.5 BMS Identification Standards

.1 Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

.2 Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

.6 BMS Panel Installation

.1 The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

.2 The BMS trade shall be responsible for coordinating panel locations with other trades and electrical and mechanical trade.

.7 Input Devices

.1 All Input devices shall be installed per the manufacturer recommendation

.2 Locate components of the BMS in accessible local control panels wherever possible.

.8 HVAC Input Devices - General

.1 All Input devices shall be installed per the manufacturer recommendation

.2 Locate components of the BMS in accessible local control panels wherever possible.

.3 The mechanical trade shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

.4 Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

.5 Outside Air Sensors

.1 Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.

.2 Sensors shall be installed with a rain proof, perforated cover.

.6 Water Differential Pressure Sensors

.1 Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.

.2 Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.

.3 The transmitters shall be installed in an accessible location wherever possible.

.7 Medium to High Differential Water Pressure Applications (Over 21" w.c.):

.1 Air bleed units, bypass valves and compression fittings shall be provided.

.8 Building Differential Air Pressure Applications (-1" to +1" w.c.):

.1 Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.

.2 The interior tip shall be inconspicuous and located as shown on the drawings.

.9 Air Flow Measuring Stations:

.1 Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.

.2 Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.

.10 Duct Temperature Sensors:

.1 Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.

.2 The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.

.3 For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.

.4 The sensor shall be mounted to suitable supports using factory approved element holders.

.11 Space Sensors:

.1 Shall be mounted per ADA requirements.

.2 Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

.12 Low Temperature Limit Switches:

.1 Install on the discharge side of the first water or steam coil in the air stream.

.2 Mount element horizontally across duct in a serpentine pattern ensuring each square foot of coil is protected by 1 foot of sensor.

.3 For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

.13 Air Differential Pressure Status Switches:

.1 Install with static pressure tips, tubing, fittings, and air filter.

.14 Water Differential Pressure Status Switches:

.1 Install with shut off valves for isolation.

.9 HVAC Output Devices

.1 All output devices shall be installed per the manufacturers' recommendation. The mechanical trade shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.

.2 Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.

.3 Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.

.4 Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.

.5 Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel) or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.20 WIRING

.1 All control and interlock wiring shall comply with provincial electrical codes, standards and Division 26.

.2 All NEC Class 1 wiring shall be ULC Listed in approved conduit according to OESC and Division 26 requirements.

.3 All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet NEC Class 2 current limitations.

.4 Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in conduit may be used provided that cables are ULC Listed for the intended application. For example, cables used in ceiling plenums shall be ULC Listed specifically for that purpose.

.5 All wiring in mechanical, electrical, or service rooms-or where subject to mechanical damage- shall be installed in conduit.

.6 Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

.7 Do not install wiring in conduit containing tubing.

.8 Where plenum rated cable is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.

.9 Where plenum rated cable is used without conduit, it shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical conduits, piping, or ceiling suspension systems.

.10 All wire-to-device connections shall be made at a terminal block or wire nut. All wire-to-wire connections shall be at a terminal strip or wire nut.

.11 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent

restriction to devices and terminals.

.12 Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, this Division shall provide step-down transformers or interposing relays.

.13 All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points

.14 All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.

.15 Maintain fire rating at all penetrations. Install plenum wiring in sleeves where it passes through walls and floors.

.16 Size and type of conduit and size and type of wire shall be the responsibility of the Trade, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.

.17 Include one pull string in each conduit 3/4 in. or larger.

.18 Control and status relays are to be located in designated enclosures only. These enclosures can include packaged equipment control panel enclosures unless they also contain Class 1 starters.

.19 Conceal all conduit, except within mechanical, electrical, or service rooms. Install conduit to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes, gas vents or flues).

.20 Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes may not be hung on flexible duct strap or tie rods. Conduits may not be run on or attached to ductwork.

.21 Adhere to this specification's Division 26 requirements where conduit crosses building expansion joints.

.22 This Division shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

.23 Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal conduit less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

.24 Conduit must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.

3.21 COMMUNICATION WIRING

.1 This Division shall adhere to the items listed in the "Wiring" article 3.14.

.2 All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

.3 Do not install communication wiring in raceway and enclosures containing NEC Class 1 or other Class 2 wiring.

.4 Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

.5 Trade shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

.6 When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to the manufacturer's instructions.

.7 All runs of communication wiring shall be unspliced length when that length is commercially available.

.8 All communication wiring shall be labeled to indicate origination and destination data.

.9 Grounding of coaxial cable shall be in accordance with OESC and NEC regulations on "Communications Circuits, Cable, and Protector Grounding."

3.22 INPUT/OUTPUT INTERFACE

.1 Hardwired inputs and outputs may tie into the system through building or application specific controllers.

.2 All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no

damage to the controller.

.3 Binary inputs shall allow the monitoring of On/Off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.

.4 Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.

.5 Analog inputs shall allow the monitoring of low-voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with-and field configurable to-commonly available sensing devices.

.6 Binary outputs shall provide for On/Off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have three-position (On/Off/Auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

.7 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC, 4 to 20 mA or 0-20 PSI signal as required to provide proper control of the output device. Analog outputs on building or custom application controllers shall have status lights and a two-position (AUTO/MANUAL) switch and manually adjustable potentiometer for manual override. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

.8 Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

.9 System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

3.23 INSTALLATION OF SENSORS

.1 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 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 Sensors used in mixing plenums and hot and cold decks shall be of the averaging type.
- .6 Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across the full face of the coil.
- .7 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
- .8 Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

.2 Room Instrument Mounting
- .1 Room instruments, including but not limited to wall mounted thermostats and sensors located in occupied spaces shall be mounted 48” (1200mm) above the finished floor unless otherwise shown.

.3 Instrumentation Installed in Piping Systems
- .1 Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.
- .2 Gauges in piping systems subject to pulsation shall have snubbers.
- .3 Gauges for steam service shall have pigtail fittings with isolation valve.

.4 Duct Smoke Detectors
- .1 Duct smoke detectors will be provided by the Fire Alarm System Trade in supply and return air

ducts in accordance with Division 26

.2 Trade shall connect the DDC System to the auxiliary contacts provided on the Smoke Detector as required for system safeties and to provide alarms to the DDC system.

.5 Averaging Temperature Sensing Elements

.1 Sensing elements shall be installed in a serpentine pattern.

.2 Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

.6 Relative Humidity Sensors

.1 Relative humidity sensors in supply air ducts shall be installed at least 10 feet (3.0 M) downstream of humidity injection elements.

3.24 ACTUATORS

.1 Mount and link control damper actuators according to manufacturer's instructions.

.1 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.

.2 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

.3 Provide all mounting hardware and linkages for actuator installation.

.2 Electric/Electronic

.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° 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 Identification of Tubing and Wiring

.1 All wiring and cabling including that within factory-fabricated panels shall be labeled at each end within 2” (5 cm) of termination with the DDC address or termination number.

.2 Permanently label or code each point of field terminal strips to show the instrument or item served.

.3 All pneumatic tubing shall be labeled at each end within 2” (5 cm) of termination with a descriptive identifier.

3.25 IDENTIFICATION OF HARDWARE AND WIRING

.1 All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 2” (5 cm) of termination with the DDC address or termination number.

.2 All pneumatic tubing shall be labeled at each end within 2” (5 cm) of termination with a descriptive identifier.

.3 Permanently label or code each point of field terminal strips to show the instrument or item served.

.4 Identify control panels and major control components on outside with minimum ½” (1 cm) 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 ULC or CSA labels are to be visible and legible after equipment is installed.

.8 Identifiers shall match record documents.

.9 Degrease and clean surfaces to receive adhesive for identification materials.

.10 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer (VOC content not to exceed 680 g/L).

.11 Install tags with corrosion resistant chain.

.12 Clearly identify abandoned services left in place as "ABANDONED".

.13 For each item of equipment which may be started automatically or remotely, add a red lamacoid plate, 2-3/8" x 9" (60 x 230 mm), reading: **"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED. IT MAY START AT ANY TIME."**

.14 Provide colour coded self-adhesive dots to locate control devices and panels located above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.26 EQUIPMENT TESTING AND INSPECTION

.1 Test operation of equipment installed under this Division according to instructions in appropriate articles of this Division. Make any required adjustments or replacements to ensure equipment is operating as intended. Retest equipment requiring adjustment or replacement.

.2 Pay all fuel consumption charges for equipment under testing and during commissioning.

.3 Conduct tests before application of external insulation and before concealment of piping or ductwork.

.4 Arrange and pay for inspections by authorities as required by code and complete any changes or alterations required by such inspections.

.5 Conduct tests in the presence of:

.1 Authorized inspector(s) for authorities having jurisdiction.

.2 The Commissioning Agent.

.3 The Consultant.

.4 The Owner's Representative.

.6 Notification must be given at least 48 hours in advance of tests being conducted, to all persons required to be present.

3.27 ADJUST AND CLEAN

.1 Clean up all debris resulting from their activities daily. Remove all cartons, containers, crates, etc. as soon as their contents have been removed. Collect and sort waste and deposit in designated locations.

.2 At the completion of work in any area, clean all work keeping it free from dust, dirt, and debris. Check all equipment furnished under this Divison for paint damage. Repair any factory-finished paint that has been damaged to match the adjacent areas. Any equipment item, cabinet or enclosure that has been deformed shall be replaced with new material and painted to match adjacent areas.

.3 Lubricate mechanical equipment installed under this Division.

.4 Test and adjust control devices, instrumentation, valves, dampers, etc. installed under this Division after cleaning of systems and leave in perfect order ready for operation.

.5 Remove from the premises upon completion of work of this Division, debris, surplus, and waste materials resulting from operations.

END OF SECTION

1 GENERAL

1.1 RELATED SECTIONS

.1 The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of this specification and shall be used in conjunction with this section as a part of the contract documents. Consult them for further instructions pertaining to this work.

.2 The following sections but not limited to constitute related work:

- .1 Section 20 01 01 - General Requirements
- .2 Section 22 11 23 – Plumbing Pumps
- .3 Section 22 30 00 – Plumbing Equipment
- .4 Section 23 05 14 – Variable Frequency Drive
- .5 Section 23 21 13 – Hydronic Pumps
- .6 Section 23 34 00 – HVAC Fans
- .7 Section 23 52 19 – Boilers, Electric
- .8 Section 23 74 00 – Packaged Rooftop Units
- .9 Section 23 82 00 – Terminal Heat Transfer Units
- .10 Section 23 83 00 – Radiant Floor Heating System
- .11 Section 25 90 00 - Sequence of Operations

.3 Products furnished but not installed under this section:

- .1 Temperature & Pressure Sensor Wells and Sockets
- .2 Motorized dampers and valves

1.2 COMMON WORK RESULTS

.1 Section 20 05 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 ACRONYMS

.1	ADC	Analog to Digital Converter
.2	AHJ	Authority Having Jurisdiction
.3	AHU	Air Handling Unit
.4	AI	Analog Input
.5	ASC	Application Specific Controller
.6	BAS	Building Automation System
.7	BMS	Building Management System (synonymous with BAS)
.8	CAFV	Controllable Air Flow Venturi
.9	CSR	Current Sensing Relay
.10	EMCS	Energy Management and Control System (synonymous with BAS)
.11	FMS	Facility Management System (synonymous with BAS)
.12	HTML	Hypertext Markup Language
.13	LAN	Local Area Network
.14	IOM	Input / Output Module
.15	IT	Information Technology
.16	OWS	Operator Work Station
.17	PC	Personal Computer(s)
.18	PID	Proportional, Integral, Derivative
.19	TCP/IP	Transmission Control Protocol / Internet Protocol
.20	UI	User Interface
.21	XML	Extensible Markup Language

1.4 DESCRIPTION

.1 General: Provide Building Automation System (BAS) to include all controls of equipment specified and in accordance with the sequences of operation.

.2 The control system shall consist of a high-speed, peer-to-peer, BACnet Testing Labs (BTL) listed network of DDC controllers, all of the same family and manufacturer, residing and communicating on a BACnet IP (Internet Protocol) network. The system software shall combine engineering and user

functionality into a singular instance interface, (no dissimilar manufacturers), be server based and accessible via the owner's network portal to the internet.

.3 Users will interface with the system network via dashboard style multi-tasking custom animated 3D Dynamic color graphics. Access and manipulation of the system must be available via ALL of the following media and devices: current versions of Windows, Android and Apple OS devices operating in workstation, tablet or smart phone device platforms. The system shall support unlimited users.

.4 The dashboard style package interface shall be of the same manufacturer as the controller manufacturer and have pre-built dashboard "widgets" as well as support custom dashboard widget development, as well as audit log, alarm management, trending graphics, remote access, set point adjustment, schedule changes, calendar changes, point overrides over the Owner's WAN and the Internet.

.5 The system shall incorporate all owner-defined, specified herein collected data as well as derived virtual data, (examples: building environmental, weather, utility, attendance and comparison data) and represent the information in a non-text, graphic form such as charts, graphs and other standard representations that various financial and operational personnel can utilize.

.6 Each mechanical system, building floor plan, and control device, will be depicted by point-and-click real-time dynamic graphics as well as standard information tree format. The owner shall be presented with a minimum of 8 standard widgets.

.7 System Object Capacity. The system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement.

.8 The system shall provide for future expansion to include fully functional access control software that supports credential readers, door controllers and card users at no additional cost. Advanced lighting control software shall also be included and shall support daylight harvesting, and central switching strategies.

1.5 BUILDING MANAGEMENT SYSTEM SUBCONTRACTOR

.1 All work of this Section shall be coordinated and provided by a single Building Management System (BMS) subcontractor.

.2 System shall be open protocol. Contractor shall submit in writing confirmation that system is open protocol upon start of project.

.3 The work of this Section shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 25 Sections for details.

.4 The work of this Section shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, warranties, services, and items which are required for the complete, fully functional and commissioned BMS, even if these are not specifically mentioned or fully described under this Section.

.5 If the BMS subcontractor believes there are conflicts or missing information in the project documents, the subcontractor shall promptly request clarification and instruction from the design team.

1.6 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

.1 Acceptable Systems:

- .1 Convergent
- .2 Trane
- .3 Delta Controls
- .4 Johnson Controls
- .5 Honeywell
- .6 Siemens
- .7 Facility Explorer – N4
- .8 Honeywell WEBS – N4
- .9 Distech EC – Net4
- .10 Andover

.11 Reliable
.12 Automated Logic

1.7 QUALITY ASSURANCE

.1 Contractor/Manufacturer Qualifications
.1 The system shall be designed and installed, commissioned and serviced by factory trained personnel. BAS contractor shall have an in-place support facility within 50 km of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. The BAS contractor shall provide full time, on site, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the BAS. The Bidder shall be regularly engaged in the installation and maintenance of BAS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BAS systems that are similar in size and complexity to this project.
.2 All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off the shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner in writing. Spare parts shall be available for at least 5 years after completion of this contract.

1.8 CODES AND STANDARDS

.1 All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:
.1 Ontario Electrical Safety Code (OESC)
.2 National Electric Code (NEC)
.3 Uniform Building Code (UBC)
.1 Section 608, Shutoff for Smoke Control
.2 Section 403.3, Smoke Detection Group B Office Buildings and Group R, Division 1 Occupancies
.3 Section 710.5, Wiring in Plenums
.4 Section 713.10, Smoke Dampers
.5 Section 1106 Refrigeration Machinery Room
.6 Section 1107, Refrigeration Machinery Room Ventilation
.7 Section 1108, Refrigeration Machinery Room Equipment and Controls
.8 Section 1120, Detection and Alarm Systems
.4 Uniform Mechanical Code (UMC)
.5 Ontario Building Code (OBC)
.6 ASHRAE 135-2001
.7 FCC Regulation, Part 15- Governing Frequency Electromagnetic Interference
.8 Underwriters Laboratories UL916

1.9 SYSTEM PERFORMANCE

.1 Performance Standards.
.1 The system shall conform to the following:
.1 Graphic Display. The system shall be dashboard based, and also capable of displaying a graphic with 20 dynamic points/objects with all current data within 10 seconds.
.2 Graphic Refresh. The system shall update a graphic with 20 dynamic points/objects with all current data within 8 seconds
.3 Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than 2 seconds. Analog objects should start to adjust within 2 seconds
.4 Object Scan. All changes of state and change of analog values will be transmitted over the high-speed Ethernet network such that any data used or displayed at a

controller or workstation will have been current within the previous 2 seconds

.5 Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds

.6 Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 1 second. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.

.7 Performance. Programmable controllers shall be able to execute DDC PID control loops at a frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency

.8 Multiple Alarm Annunciation. All workstations on the network must receive alarms within 5 seconds of each other.

.9 Reporting Accuracy. The system shall report all values with an end-to-end accuracy as listed or better than those listed in Table 1.

.10 Energy Reporting: The operating software shall have as standard, dashboard widgets which can be selected by the operator to create individual interface points as well as multi-trend graphics as standard.

.11 Stability of Control. Control loops shall maintain measured variable at setpoint within the tolerances listed in Table 2

.2 TABLE 1: Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC [±1ºF]
Ducted Air	±0.5ºC [±1ºF
Outside Air	±1.0ºC [±2ºF]
Dewpoint	±1.5ºC [±3ºF]
Water Temperature	±0.5ºC [±1ºF]
Delta-T	±0.15ºC[±0.25ºF]
Relative Humidity	±5% RH
Water Flow	±5% of full scale
Airflow (terminal)	±10% of full scale *(see Note 1)*
Airflow (measuring stations)	±5% of full scale
Air Pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air Pressure (space)	±3 Pa [±0.01 "W.G.]
Water Pressure	±2% of full scale *(see Note 2)*
Electrical (A, V, W, Power factor)	5% of reading *(see Note 3)*
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO_2)	±50 ppm
Note 1: 10%-100% of scale	
Note 2: For both absolute and differential pressure	
Note 3: Not including utility-supplied meters	

.3 TABLE 2: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa [±0.2" w.g.] ±3 Pa [±0.01" w.g.]	0-1.5 kPa [0-6" w.g.] -25 to 25 Pa [-0.1 to 0.1" w.g.]
Airflow	±10% of full scale	
Temperature	±0.5ºC [±1.0ºF]	
Humidity	±5% RH	
Fluid Pressure	±10 kPa [±1.5 psi]	0-1 kPa [1-150 psi]
" " differential	±250 Pa [±1.0" w.g.	0-12.5 kPa [0-50"w.g.]

1.10 SUBMITTALS

.1 Product Data and Shop Drawings: Contractor shall provide a copy of shop drawings and/or other submittals on all hardware, software, and installation to be provided. No work may begin on any segment of this project until submittals have been reviewed for conformity with the design intent. The shop drawings shall ensure that identifying numbers on the shop drawings correspond to equipment identification, as specified elsewhere in the Specifications. The locations of all equipment shall be identified. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall include:

- .1 All automatic temperature, pressure and humidity control components, including maintenance of all equipment and service manuals.
- .2 Provide a detailed network layout indicating the type of controller and model number, location, power source (panel and breaker I.D.) and routing of wiring
- .3 Identified schematic control diagrams for all systems, each diagram indicating control component catalogue numbers, operation sequence, and interlocking.
- .4 Descriptive data and sequence of operation for all systems.
- .5 A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and software for the system server / Operator Workstation included in the submittal. PICS to include for each product, as a minimum, a list of BACnet functional groups supported, BACnet services supported, BACnet data link options available and BACnet objects provided.

.2 Project Record Documents: Upon completion of installation, submit electronic copy of record (as built) documents. The documents shall be submitted for approval prior to final completion and shall include Project Record Drawings which shall be as-built versions of the submittal shop drawings; Testing and Commissioning Reports and Checklists; Electrical Safety Authority Final Inspection Certificate; and other materials needed for inclusion in the Operation and Maintenance (O & M) Manual.

1.11 WARRANTY

.1 Warrant all work as follows:

- **.1** Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The Contractor shall provide 24/7 support, respond to the Owner's request for one-year standard warranty service within 24 hours during normal business hours.
- **.2** At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Owner, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty.
- **.3** Operator workstation software, project-specific software, graphic software, database software,

and firmware updates which resolve known software deficiencies as identified by the Contractor shall be provided at no charge during the warranty period. Any upgrades or functional enhancements associated with the above-mentioned items also can be provided during the warranty period for an additional charge to the Owner by purchasing an in-warranty technical support agreement from the Contractor. Written authorization by the Owner must, however, be granted prior to the installation of any of the above-mentioned items.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

.1 All project-developed software and documentation shall become the property of the Owner. These include, but are not limited to:
- .1 Project graphic images
- .2 Record drawings
- .3 Project database
- .4 Project-specific application programming code
- .5 All documentation

2 PRODUCTS

.1 Section includes:

- .1 Materials
- .2 Communication
- .3 Operator Workstation and Dashboard Widgets
- .4 Controller Software
- .5 Building Controllers
- .6 Advanced Application Controllers
- .7 Application Specific Controllers
- .8 Auxiliary Control Devices
- .9 Wiring and Raceways

2.1 MATERIALS

.1 All products used in this project installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's Representative in writing. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

.1 All control products provided for this project shall comprise a BACnet internetwork. Communication involving control components (i.e., all types of controllers and Operator Workstations) shall conform to ANSI/ASHRAE Standard 135-2008, BACnet.

.2 Each BACnet device shall operate on the BACnet Data Link/Physical layer protocol specified for that device as defined in this section.

.3 The Contractor shall provide all communication media, connectors, repeaters, bridges, hubs, switches, and routers necessary for the internetwork.

.4 All controllers shall be native BACnet Controllers that communicate on a Twisted Pair 10-BaseT BACnet/IP and/or BACnet over Ethernet network; each shall have a communication port of connections with the operator interfaces using the BACnet Data Link/Physical layer protocol.

.5 All controllers shall have a communication port for connections with the Operator Workstations using the BACnet Data Link/ Physical layer protocol.

.6 Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:

- .1 Connection of an Operator Workstation device to any one controller on the internet work will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any

one controller on the internetwork.

.2 All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.

.7 The time clocks in all applicable controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the network.

2.3 OPERATOR WORKSTATION

.1 Operator Workstation: Use Owner provided PC-based workstations; they shall be able to access all information in the system. Provide required software to all Owner PC-based workstations.

.2 Workstation information access shall use the BACnet protocol. Communication shall use the ISO 8802-4 (Ethernet) Data Link/Physical layer protocol.

.3 System Software

.1 Operating System: Windows 10, provided by Owner.

.2 System Graphics. The operator workstation software shall be a graphical user interface (GUI). The system shall allow display of up to 10 dynamic and animated graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on-line. An operator with the proper password level shall be able to add, delete, or change dynamic objects on a graphic. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the object.

.3 Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics. The graphics generation package also shall provide the capability of capturing or converting graphics from other programs such as Visio or AutoCAD.

.4 Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program. Graphics shall be created by drag-and-drop selection of graphic symbols and drag-and-link with BACnet objects with dynamic and interactive display fields.

.5 Multilingual. Software shall be supported in the following languages English, Spanish, French, German, and Chinese.

.6 Dynamic Data Exchange (DDE). Software shall support dynamic data sharing with other Windows-based programs for third party add-on functionality e.g. preventative maintenance, tenant billing, etc.

.4 System Applications. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation:

.1 System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each Building Controller. This database shall be updated whenever an operator initiates a save command.

.2 Manual Database Save and Restore. A system operator with the proper password clearance shall be able to save the database from any system panel. The operator shall be able to clear a panel database via the network and may initiate a download of a specified database to any panel in the system from the network.

.3 System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection.

.4 On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in

operating and editing the system. On- line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

.5 Security. 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.

.6 System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers.

.7 Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, alarm limit differentials, states, and reactions for each object in the system.

.8 Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm, in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying upon acronyms or other mnemonics.

.9 Alarm Reactions. The operator shall be able to determine (by object) what if any actions are to be taken during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation.

.10 Trend Logs. The operator shall be able to define a custom trend log for any data object in the system. This definition shall include change-of-value digital, change-of-value analog, time interval, start time, and stop time. Trend data shall be sampled and stored on the Building Controller panel, and be achievable on the hard disk and be retrievable for use in spreadsheets and standard database programs.

.11 Alarm and Event Log. The operator shall be able to view all system alarms and change of states from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms.

.12 Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system. The status shall be available by menu, on graphics, or through custom programs.

.13 Clock Synchronization. The real-time clocks in all building control panels and workstations shall be using the BACnet Time Synchronization service. The system also shall be able to automatically synchronize all system clocks daily from any operator-designated device in the system. The system shall automatically adjust for daylight savings and standard time, if applicable.

.5 Workstation Applications Editors shall support editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at one or more of the controller panels.

.1 Controller. 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 setpoints for all controllers.

.2 Scheduling. 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.

.3 Custom Application Programming. 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. The programming language shall have the following features:

.1 The language shall be English language oriented, be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and allow for free-form programming (i.e., not column-oriented or "fill in the blanks").

.2 A full-screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add,

modify, and delete custom programming code. It also shall incorporate word processing features such as cut/paste and find/replace.

.3 The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.

.4 The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and observe any intermediate values and/or results. The debugger also shall provide error messages for syntax and execution errors.

.5 The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

.6 The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and x-to-the-y-power. The following mathematical functions also shall be provided: natural log, log, trigonometric functions (sine, cosine, etc.), absolute value, and minimum/maximum value from a list of values.

.7 The programming language shall have predefined variables that represent time of day, day of the week, month of the year, and the date. Other predefined variables shall provide elapsed time in seconds, minutes, hours, and days. These elapsed time variables shall be able to be reset by the language so that interval-timing functions can be stopped and started within a program. Values from all of the above variables shall be readable by the language so that they can be used in a program for such purposes as IF/THEN comparisons, calculations, etc.

.8 The language shall be able to read the values of the variables and use them in programming statement logic, comparisons, and calculations.

.9 The programs shall support online changes with the ability to read real time values without exiting the program. Sample programs and syntax help functions shall be resident in the program.

.6 Widgets

.1 Furnish graphical user interface screen widgets for use in the dashboard with the following content:

.1 Energy consumption comparison pie-chart (in color) showing total energy in BTU by meter.

.2 Multitrend template for comparing up to 5 trend points on the same graph

.3 Load profile line chart showing the current month’s electrical demand in kW versus the same month last year.

.4 A dynamic point schedule for each mechanical system that shows all input and output points in a table format. Changes in object names made by the system operator (like “DAT” changing to “Supply Air Temperature”) must be automatically updated in the point list without operator entries.

.5 An alarm summary view that includes all alarms from priority one thru eight.

.7 Report Management

.1 The following reporting capability shall be provided at the operator workstation.

.1 User definable query reports (support advanced multiple property, multiple object).

.2 Reports shall be scheduled for automatic generation by schedule or event.

.3 Manual execution to printing/file.

.4 Ability to save report in system report folder.

.5 Report to multiple destinations

.6 Query controller hierarchy.

.1 Email

.2 Print

.3 File (text, csv, xml)
.4 Terminal

.8 Web Browser Interface
.1 The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Chrome or Firefox.
.2 The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the BAS, shall not be acceptable.
.3 The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
.4 The Web browser client shall support at a minimum, the following functions:
.1 User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
.5 Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
.6 HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
.7 Storage of the graphical screens shall be in the Server, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
.8 Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
.9 User’s shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
.1 Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
.10 Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
.11 Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
.12 The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
.13 Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

.9 Server Functions and Hardware
.1 The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.
.2 The server shall provide central management of alarm data for all Network Area controllers supported by the server inclusive of the following:
.1 View and acknowledge alarms
.2 View and edit comments on acknowledged alarms
.3 Server Hardware Requirements: The server hardware platform shall have the following requirements.

.1 The computer shall have: Intel I5 Quad Core processor, 3 GHz, 4GB DDR3 SDRAM, 500GB drive space. It shall include a DVD RW Drive, USB ports, NICs and 1024x768 True Color Video Card.

.4 The server operating system shall be Microsoft Windows 7 or 10.

2.4 CONTROLLER SOFTWARE

.1 Furnish the following applications software for building and energy management. All software applications shall reside and operate in the system controllers. Editing of applications shall occur at the operator workstation

.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 User Log On/Log Off attempts shall be recorded.

.3 Scheduling. Provide the capability to schedule each object or group of objects in the system. Each schedule shall consist of the following:

.1 Provide an event scheduling system that allows the operator to specify a single event, multiple day event and/or recurring events. The event schedule specifies both the on/off times and the date in a calendar planning format similar to Microsoft Outlook®.

.2 Calendar Schedules. Provide the capability for the operator to define up to 99 special schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

.4 Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions.

.5 Remote Communication. The system shall have the ability to communicate out of the system top the internet in the event of an alarm using BACnet Point-To-Point attributes. Messaging capability shall include email service.

.6 Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user-designated run-time, starts, and/or calendar date limits.

.7 Sequencing. Provide application software to properly sequence the start and stop of chillers, boilers, and pumps to minimize energy usage in the facility.

.8 PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-windup shall be supplied. 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 PID gains shall be user-selectable.

.9 Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage.

.10 Anti-Short Cycling. All binary output objects shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

.11 On/Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and setpoint. The algorithm shall be direct-acting or reverse-acting, and incorporate an adjustable differential.

.12 Run-time Totalization. Provide software to totalize run-times for all binary input objects. A high run-time alarm shall be assigned, if required, by the operator.

2.5 BUILDING CONTROLLERS

.1 General. Provide an adequate number of fully programmable, BTL listed, UL 916 certified, expandable modular style native BACnet® Building Controllers to achieve the performance specified. Building Controllers shall support the following minimum communication methods as standard; BACnet/IP, BACnet over Ethernet and BACnet MS/TP.

.2 The controller shall be expandable in functionality and shall consists of a main control unit and multiple DIN rail mounted, removable plug in modular component which shall include the following:

.1 The unit shall contain the primary 32 – bit RISC CPU, 64 MB flash memory and 32 MB SDRAM storage memory with SD/SDIO card slot for memory expansion, a real-time clock (temperature compensated), as well as Ultracap power backup for real time clock & memory.

.2 Standard Communications ports shall include as minimum external 3 Port 10/100 Ethernet Switch communication ports, (2) RS-485 Ports (up to 76800 bps) as well as 2 USB host ports. The manager unit shall communicate and provide the control logic for the plug in I/O modules via expansion backplanes. The manager must be able to communicate with sufficient plug in modules to accommodate 500 connected I/O points at one time.

.3 Controller activity of power/scan and Ethernet ports shall be indicated through face mounted LED status light indications.

.3 The modular I/O components shall be hot swappable and provide a variation of input or output ranges by positioning of jumpers located on each module.

.1 Inputs. Modular controller input/output unit shall support dry contact, RTD, 0-5 VDC and 0-10 VDC- voltage, 4-20 mA- current and thermistor-resistive signal types on an individual basis for connecting any status or sensing device. Analog resolution shall be minimum 10-bit A to D.

.2 Outputs. Modular controller input/output unit shall have or built in Hand-Auto-Off (HAO) modules configured with manual-auto-off override switch, potentiometer and input channel for feedback status and/or unrelated analog or digital input. Outputs supported shall be 0-10 VDC, internal SPST relays, Triac, and internally powered current loop control from 0-20mA .

.3 All HAO's shall be supervised.

.4 Diagnostics. Modular controller input unit shall have variable intensity LEDs providing analog input status indication or configurable tri-color LEDs for binary input status indication. Outputs shall have variable intensity LEDs indicating the output voltage with Color indication of HAO's status when present.

.5 Bump-less Transfer. On outputs with override switches, provide an HAO switch either built-in or external to the board that allows for manual positioning of the output, then transferring the output to automatic without any "bump" in the output voltage, (don't go through off before transferring from manual to auto).

2.6 ADVANCED APPLICATION CONTROLLERS

.1 General. Provide an adequate number of BACnet®Advanced Application Controllers to achieve the performance specified. Each of these panels shall meet the following requirements.

.1 The Advanced Application Controller shall have sufficient memory to support its operating system, database, and programming requirements.

.2 Advanced Application Controllers shall be fully peer to peer.

.3 The operating system of the Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms.

.4 All equipment that requires scheduling shall be scheduled in that equipment's controller.

.5 Both firmware and controller database shall be loadable over the network.

.6 The controller shall have the option to be flash-loaded with the Modbus interface firmware allowing the RS-485 port to be used to communicate with Modbus RTU devices.

.7 Advanced Application Controllers shall support the following BACnet Interoperability Building Blocks (BIBBs):

Data Sharing	Alarm & Event	Scheduling	Trending	Device & Network Mgmt.
DS-RP-A,B	AE-N-I-B	SCH-I-B	T-VM-I-B	DM-DDB-A,B
DS-RPM-B	AE-N-E-B	SCH-E-B	T-VM-E-B	DM-DOB-A,B
DS-WP-A,B	AE-ACK-B		T-ATR-B	DM-DCC-B
DS-WPM-B	AE-ASUM-B			DM-TS-B
DS-COV-A,B	AE-ESUM-B			DM-RD-B
	AE-INFO-B			DM-BR-B
				DM-R-B
				DM-OCD-B

.2 Communication Each Advanced Application Controller shall reside on a BACnet network using the MS/TP or Ethernet Data Link/ Physical layer protocol.

.3 The controller shall provide a service communication port using BACnet Data Link/ Physical layer protocol for connection to portable operators workstation and allow access to the entire network.

.4 Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

.5 Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 0°C to 40°C (32°F to 100°F).

.6 Controllers used in conditioned space shall be mounted in dust proof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

.7 Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips — or to a termination card connected by a ribbon cable.

.8 Memory. The Advanced Application Controller shall utilize non-volatile FLASH memory to maintain its operating system and backup all operator entered changes to setpoints, schedules, and commands.

.9 Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.7 APPLICATION SPECIFIC CONTROLLERS

.1 General. Provide BACnet® Application Specific Controllers (ASCs) as required to execute the sequence of operations. ASCs are microprocessor based DDC controllers which through hardware or firmware design are able to control a wide variety of equipment. They shall be fully user configurable.

.2 Each ASC shall be capable of standalone operation and shall continue to provide control functions without being connected to the network.

.3 Each ASC will contain sufficient I/O capacity to control the target system.

.4 Both firmware and controller database shall be loadable over the network

.5 ASCs shall come with an integrated housing to allow for easy mounting and protection of the circuit board. Only wiring terminals shall be exposed.

.6 Application Specific Controllers shall support the following BACnet Interoperability Building Blocks (BIBBs):

Data Sharing	Alarm & Event	Scheduling	Trending	Device & Network Mgmt.
DS-RP-B				DM-DDB-B
DS-RPM-B				DM-DOB-B
DS-WP-B				DM-DCC-B
DS-COV-B				DM-TS-B
				DM-RD-B

.7 Communication: The controller shall reside on a BACnet network using the MS/TP or Ethernet Data Link/ Physical layer protocol or BACnet® over ZigBee protocol.

.8 Each controller shall have a BACnet Data Link/ Physical layer compatible connection for a laptop computer or a portable operator's tool. This connection shall be extended to a space temperature

sensor port where shown and allow access to the entire network.

.9 Environment. The hardware shall be suitable for the anticipated ambient conditions.

.10 Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°C to 65°C [40°F to 150°F] and/or suitably installed in a heated or fan cooled enclosure

.11 Controllers used in conditioned space shall be mounted in dust proof enclosures and shall be rated for operation at 0°C to 50°C [32°F to 120°F].

.12 Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips.

.13 Memory. The Application Specific Controller shall use non-volatile memory and maintain all BIOS and programming information in the event of a power loss.

.14 Immunity to power and noise. ASC shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m [3 ft].

.15 Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.

.16 Input/Output. ASC shall support as a minimum, directly connected, a combination of analog outputs and binary outputs and universal software selectable analog or digital inputs. ASC inputs shall support 0-5 VDC-voltage, 4-20mA-current, thermistor-resistance and dry contacts. ASC outputs shall support 0-10 VDC-voltage, digital triac rated at 0.5 amps at 24 VAC.

2.8 INPUT/OUTPUT INTERFERENCE

.1 Hardwired inputs and output points/objects may be wired into the system through Building, Custom Application, or Application Specific Controllers.

.2 All input and output points shall be protected such that shorting of the point to itself, to another point, or to ground, will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 volts of any duration, such that contact with this voltage will cause no damage to the controller.

.3 Digital inputs shall allow the monitoring of ON/OFF signals from remote devices. The digital inputs shall provide a current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Digital inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

.4 Analog inputs shall allow the monitoring of 0-5 VDC, 0-10 VDC-voltage, 4-20 mA-current, or thermistors. Analog inputs shall be compatible and be field configurable to commonly available sensing devices.

.5 Digital outputs shall provide for ON/OFF operation. Digital outputs on Building and Custom Application Controllers shall have three-position override switches, Hand-Off-Auto with status lights. Outputs shall be selectable for either normally open or normally closed operation.

.6 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide a 0 to 10 VDC signal as required to provide proper control of the output device. Analog outputs on Building or Custom Application Controllers shall have status lights and a two-position (AUTO/MANUAL) switch and manually adjustable potentiometer for manual override. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

.7 Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct mounted heating coils, zone dampers, radiation, etc.)

.8 Input/Output points/objects shall be universal type, i.e., controller input or output may be designated (in software) as either a binary or analog type point/object with appropriate properties. Application Specific Controllers are exempted from this requirement.

.9 Wireless sensors may be used as long as all communication between their associated controller and the rest of the network is BACnet® standard protocol.

.10 System Object Capacity. The system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The Operator

Workstations installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.9 POWER SUPPLIES AND LINE FILTERING

.1 Control transformers shall be UL Listed. Furnish Class 2 current-limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per 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 3 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.

.3 24VAC/120VAC units shall be UL recognized CSA/Ontario Hydro approved - Durell CP15OR or equal.

2.10 AUXILIARY CONTROL DEVICES

.1 Motorized control dampers, unless otherwise specified elsewhere, shall be furnished by the controls contractor.

.2 Electric damper/valve actuators.

.1 The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

.2 Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing.

.3 All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 7 N•m [60 in-lb] torque capacity shall have a manual crank for this purpose.

.3 Control Valves

.1 Control valves shall be two-way or three-way type for two-position or modulating service as shown.

.2 Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

.1 Water Valves:

.1 Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.

.4 Binary Temperature Devices

.1 Low-limit thermostats. Low-limit thermostats shall be vapor pressure type with an element 6 m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any 30 cm [1 ft] section. The low-limit thermostat shall be manual reset only and be supplied as DPST.

.5 Temperature sensors.

.1 Temperature sensors shall be thermistors.

.2 Space sensors shall be equipped with the following:

.3 Programmable buttons for setpoint adjustment and override 3-value, 96-segment LCD display

.4 Communication port connected to entire network

.1 Provide matched temperature sensors for differential temperature measurement.

.6 Humidity sensors.

.1 Duct and room sensors shall have a sensing range of 20% to 80%. A combination sensor for room temperature and humidity shall be provided where it applies.

.2 Duct sensors shall be provided with a sampling chamber.

.3 Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH.

.4 They shall be suitable for ambient conditions of -40°C to 75°C [-40°F to 170°F]. Humidity sensor's drift shall not exceed 3% of full scale per year.

.7 Flow switches.

.1 Flow-proving switches shall be either paddle or differential pressure type, as shown.

.8 Relays.

.1 Control relays shall be UL Listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application

.2 Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from setpoint shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

.9 Override timers.

.1 Override timers shall be spring-wound line voltage UL Listed, contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified; suitable for flush mounting on control panel face, located on local control panels or where shown.

.10 Current transmitters

.1 AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 0 – 5vdc two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, 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.

.11 Pressure transducers

.1 Transducer shall have linear output signal. Zero and span shall be field adjustable.

.2 Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage

.3 Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 1 - 5vdc or 4 to 20 mA output, required mounting brackets, and block and bleed valves.

.4 Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 1 – 5vdc or 4 to 20 mA output, required mounting brackets, and five-valve manifold. Accuracy is better than 1% of full-scale reading.

.5 Standard of acceptance: Greystone or approved equal.

.12 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 shown.

.13 Local control panels

.1 All indoor control cabinets shall be fully enclosed NEMA 1 construction with hinged door, key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels.

.2 Interconnections between internal and face-mounted devices pre-wired with color coded stranded conductors neatly installed in plastic troughs and/or tie wrapped.

.3 Control terminations for field connection shall be individually identified per control drawings

.4 Provide 120v receptacle at each local panel location.

2.11 WIRING AND RACEWAYS

.1 General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 26. Comply with Canadian Electrical Code and Provincial and local codes.

.2 All insulated wire to be copper conductors, UL labeled for 90C minimum service.

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/Owner 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 Owner for resolution before rough-in work is started

3.2 PROTECTION

.1 The Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused

.2 The Contractor shall be responsible for its 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

3.3 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 its 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 its work to correct the condition without extra charge

.2 Coordinate and schedule work with all other work in the same area, or with work, which is dependent upon other work, to facilitate mutual progress.

.2 Submittals. Refer to the “Submittals” of this specification for requirements

.3 Test and Balance

.1 The Contractor shall furnish 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, until the first 20 terminal units are balanced.

.4 The tools used during the test and balance process will be returned at the completion of the testing and balancing

.4 Life Safety

.1 Duct smoke detectors required for air handler shutdown are supplied and installed under Division 26. The Division 26 Contractor shall interlock smoke detectors to air handlers for shutdown.

.2 Smoke dampers and actuators required for duct smoke isolation are provided under Division 23. Control of these dampers shall be by Division 25 and 26.

.3 Fire/Smoke dampers are actuators required for fire rated walls are provided under Division 23. Control of these dampers by Division 25 and Division 26.

.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 controls product is responsible for the configuration, programming, start-up, 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.

3.4 COORDINATION OF WORK BY OTHERS

.1 The demarcation of work and responsibilities between the BMS Contractor and other related Divisions shall be as outlined below in the BMS RESPONSIBILITY MATRIX. This Section shall be responsible for coordinating all work with other parties.

BMS RESPONSIBILITY MATRIX				
WORK	**SUPPLY**	**INSTALL**	**LOW. VOLT. WIRING/ CONDUIT**	**POWER WIRING/ CONDUIT**
BMS low voltage and communication wiring	25	25	25	N/A
BMS conduits and raceway	25	25	25	25
Pipe insertion devices and taps including thermo wells, flow and pressure station	25	23	25	25
Automatic valves	25	23	25	N/A
Automatic dampers	23	23	N/A	N/A
Automatic damper actuators	25	25	25	25
Fire/Smoke Dampers	23	23	26	26
Fire Dampers	23	23	N/A	N/A
Smoke Detectors	26	26	26	26
Fire Alarm shutdown relay interlock wiring	26	26	26	26
Fire Alarm smoke control relay interlock wiring	26	26	26	26
VFDs	22/23	22/23	25	26
Isolation Room Pressure Monitors	25	25	25	25
BAS Controllers	25	25	25	25

3.5 GENERAL WORKMANSHIP

.1 Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
.2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment
.3 Install all equipment in readily accessible locations as defined by OESC.
.4 All wiring shall be verified for its integrity to ensure continuity and freedom from shorts and grounds
.5 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.

3.6 FIELD QUALITY CONTROL

.1 All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification
.2 Contractor shall continually monitor the field installation for code compliance and quality of workmanship
.3 Contractor shall have work inspected by local and/or state/provincial authorities having jurisdiction over the work

3.7 WIRING

.1 All of the installation requirements, be they temporary or permanent, to comply with the Canadian

Electrical Code & all local & Provincial codes.

.2 The Contractor to supply, install & connect all conduits, boxes & wiring between the different components related to the Control System, including all required line voltage to the equipment. All power to be from appropriately sized dedicated circuits from the nearest electrical panel with space provided by the Contractor. Circuits to be identified inside each control panel & on Shop drawings using the same code. Provide circuit breaker lock-offs & clearly mark breaker(s) with "BAS".

.3 All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 26 requirement. All high voltage wiring, 50 volts or more, to be a minimum of No. 12 gauge copper stranded T90, run in conduit.

.4 All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current-limit.) All low voltage wiring, less than 50 volts, to be a minimum of No. 18 gauge copper stranded.

.5 All MS/TP communications wiring for the local field panels to be 2 conductor, #24 shielded twisted LO CAP pairs, with ground drain wire. All drain wires to be grounded at the panel end. The other end to be protected from grounding with a dielectric material/electrical tape.

.6 Wiremold and/or raceway may not be used unless specifically approved by the Consultant. All wiring within mechanical, electrical room & exposed area to be in conduit.

.7 Two conductor #18 stranded unshielded, FT6 wiring is acceptable in all rooms except Mechanical & Electrical Rooms, & exposed areas (refer to reflected ceiling plans). Wiring to be neatly installed parallel to building lines tie rapped a minimum of every 4 feet (3.3M). Use 2 conductor #18 FT6 within all Mechanical Rooms. Use 4 conductor #18 FT6 to all points that are outside of Mechanical Rooms i.e.: Space Temp.

.8 Use thin-walled Electrical Metallic Tubing (EMT) conduit complete with watertight steel connectors at all entrances to enclosures. Steel set screw connectors & couplings will be used in all other parts of the installations. Maximum of 60% conduit fill will be allowed.

.9 Flexible conduit to be sued only in areas where vibrations and/or expansion joints are present. The length of any run of flexible conduit not exceed 2 m.

.10 All conduit to be supported at least every 1.525 m, and in accordance with the Ontario Electrical Safety Code. Supports to also be located at all junction boxes along the length of the conduit.

.11 In damp or weather exposed areas, the conduit and related equipment to be suitable for the application.

.12 All conductors to be continuous from device to panel.

.13 High and low voltage wire to not be run in the same conduit.

.14 Sensor, power and control wiring to be run in separate conduit.

.15 Where wiring penetrates fire separation, use firestop sealant to maintain fire wall ratings.

.16 New DDC panels to be mounted adjacent to the existing control cabinets, where applicable.

.17 DDC controller to be mounted in same room as equipment being controlled. Where this is not practical, provide a communication interface at equipment location for communication to DDC panel.

.18 All conduit and wiring is to comply with requirements of Division 26 and General Conditions.

3.8 WIRING IDENTIFICATION

.1 The two extremities of all wiring to be identified using the same code and cross referenced to the Record Drawings.

.2 The terminal strips to be numbered. All Drawings to show wire identification codes and terminal numbers. Flex type terminal blocks are acceptable.

.3 The identification to be done using 3 M or equivalent paper with adhesive backing labels.

.4 The following colour code to apply to all wiring:

.1	Power	White
.2	Neutral	Red, Yellow, Blue
.3	Phase leads	Black

.5 All ground wiring to be green.

.6 All 24 VAC to be brown - load side: yellow - neutral side of transformer.

3.9 PULL BOX AND JUNCTION BOX

.1 All boxes to comply with the Canadian Electrical Code in reference to size, capacity, etc. All boxes to

be fabricated to galvanized metal, unless otherwise warranted.

.2 A pull box to be located every 30 m. The Contractor is responsible for the location and for obtaining any required approvals from the Consultant.

.3 In suspended ceilings, all boxes to be installed on the structure.

.4 All boxes to be clearly marked with "BCS" as part of the energy management system.

3.10 CABINETRY

.1 All controllers will be mounted in a Nema 1 rated enclosure suitably sized to accommodate 10% I/O expansion in future. Provide a key lock type door. The door must come with mounting rails that provide the ability to fasten a mounting panel to the inside of the door if required.

.2 Panel to be mounted 6'2 from top of panel to finished floor. The door must swing free of all obstacles and open fully. Coordinate location with division 1000 electrical.

.3 All interface enclosures housing relays, transformers, EPT's, power supplies etc., will be Nema 1 type. The cabinet will have a removable backplate to mount devices on. The door will come with a latch to provide positive closure.

.4 Relay interface enclosures will be mounted adjacent to the MCC or remote starter they are associated with. Coordinate with division 16 electrical.

3.11 NAMEPLATES

.1 Identify each I/O device and panel with nameplate identifying the point descriptor using the approved naming convention.

.2 In addition to identification as described above, show B.C.S. identification label for each piece of equipment with nameplate.

.3 Index terminal strips and tag wires. Label exposed junction boxes including function and nature of service. Tag all wires within the junction boxes including purpose and nature of service.

.4 Use self-adhesive strip or clip on style plastic markers for wire tags. Secure tags to each individual wire at both ends.

3.12 SAFETY CONTROL DEVICES

.1 Control all equipment in accordance with the manufacturer's recommendations.

.2 All controls are to be connected to the control circuits of all equipment without bypassing any safety devices. The Contractor shall ensure that all equipment has the following safeties, as a minimum:

.1 Air Handling Equipment: Firestat and Freezestat.

.3 Firestat shall be high limit thermostat to be normally closed SPDT, manual reset complete with cover and case. Switch to open on temperature rise. Provide on all air handlers and exhaust fans and wire to starter 120 volt control circuit, via 24 vac DPDT relay. Wire second pole to DDC panel for indication of fire status.

.4 All wiring from firestat to starter to be 24 vac. (See detail drawing)

.5 Freezestat shall be low limit thermostat to be normally closed DPDT, manual reset. Switch to break on temperature fall. Provide 6.1 m (20') capillary sensing element. Provide on all air handling units and wired to starter 120 volt control circuit via 24 vac DPDT relay. For air handlers wire second pole of 24 vac relay to DDC panel for indication of freeze status.

.6 All wiring from freezestat to starter to be 24 VAC.

3.13 RELAYS AND CONTACTORS

.1 All interfacing/control relays and contactors to be sized to match the application. Low voltage coils to be used wherever possible, except where it is financially beneficial to use high voltage coils.

.2 For all non horsepower rated applications use mechanical 0-10 VDC coil type Feme relays or approved equal.

3.14 CONTROLLERS

.1 Provide a separate controller for each AHU or other HVAC system.

.2 Building Controllers and Advanced Application Controllers shall be selected to provide a minimum of 10% spare I/O point/object capacity for each point/object type found at each location. If input /objects are not universal, 10% of each type is required. If outputs are not universal, 10% of each type is required. A minimum of one spare is required for each type of point/object used.

.3 Future use of spare capacity shall require providing the field device, field wiring, point/object database definition, and custom software. No additional controller boards or point/object modules shall be required to implement use of these spare points

3.15 ACTUATORS

.1 Mount and link control damper actuators per manufacturer's instructions.

.1 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage

.2 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

.3 Provide all mounting hardware and linkages for actuator installation.

.2 Electric/Electronic

.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° 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.

3.16 PROGRAMMING

.1 Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

.2 Point/object Naming: System point/object names shall be modular in design, allowing easy operator interface without the use of a written point/object index. Object names shall be case-sensitive and clearly spell out the function of each object. Submit naming scheme to owner for prior approval. Do not use cryptic abbreviations. Valid examples are:

.1 AHU-1 Supply Air Temperature

.2 B-1 Boiler Water Supply Temperature

.3 FC-1 Room Temperature

.3 Software Programming

.1 Provide programming for the system and adhere to the sequences of operation provided. The Contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation.

.4 Operator Interface

.1 Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each air handler humidifier, electric heaters and all terminal equipment. Point/object information on the graphic displays shall dynamically update. Show on each graphic all input and output points/objects for the system. Also show relevant calculated points/objects such as setpoints

.2 Show terminal equipment information on a “graphic” summary table. Provide dynamic information for each point/object

.3 The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all Operator Workstation software and their functions as described in this section. This includes any operating system software, the Operator Workstation database, and any

third-party software installation and integration required for successful operation of the operator interface.

3.17 CONTROL SYSTEM CHECKOUT AND TESTING

.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. 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 per 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 correct
- .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

3.18 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

.1 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 its 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, startup, and debugging process and as specified in the "Control System Checkout and Testing" Article in Part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer 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/object 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 Demonstrate complete operation of Operator Workstation
- .9 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 setpoint, 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 setpoint, 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 setpoint, and the status of shed-able equipment outputs.

.3 Optimum Start. The Contractor shall supply a trend data output showing the capability of the algorithm. The hour by hour 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 setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the Architect/Engineer. 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.

.6 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.

.2 Acceptance

.1 All tests described in this specification shall have been performed to the satisfaction of both the Engineer 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 Engineer. Such tests shall then be performed as part of the warranty.

.2 The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: “Submittals.”

3.19 CLEANING

.1 The Contractor shall clean up all debris resulting from its activities daily. The Contractor shall remove all cartons, containers, crates, etc., under its 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 of its 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.

3.20 TRAINING

.1 General

.1 Provide a minimum of one onsite training class 8 hours in length during the construction period for personnel designated by the owner.

.2 Provide two additional training sessions at 2 and 12 months following building’s turnover. Each session shall be 4 hrs in length and must be coordinated with the building Owner.

.2 Train the designated staff of Owner’s Representative and Owner to enable Day-to-day Operators to:

.1 Proficiently operate the system.

.2 Understand control system architecture and configuration.

.3 Understand DDC system components.

.4 Understand system operation, including DDC system control and optimizing routines

(algorithms).
.5 Operate the workstation and peripherals.
.6 Log on and off the system.
.7 Access graphics, point/object reports, and logs.
.8 Adjust and change system setpoints, time schedules, and holiday schedules.
.9 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
.10 Understand system drawings, and Operation and Maintenance manual.
.11 Understand the job layout and location of control components.
.12 Access data from DDC controllers and Application Specific Controllers (ASC's).
.13 Operate portable operator's terminals.

.3 Train the designated staff of Owner's Representative and Owner to enable System Managers/Administrators to:
.1 Maintain software and prepare backups
.2 Interface with job-specific, third-party operator software
.3 Add new users and understand password security procedures

.4 Provide course outline and materials as per "Submittals" Article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.

.5 The instructor(s) shall be factory-trained instructors experienced in presenting this material.

3.21 SEQUENCES

.1 Refer to section 25 90 00.

END OF SECTION

1 GENERAL

1.1 GENERAL

.1 Read and conform to:
- .1 The Contract CCDC 2-2008, Stipulated Price Contract as amended.
- .2 Division 1 General Requirements.
- .3 Section 20 01 01 General Requirements.

1.2 SECTIONS INCLUDES

.1 Sequence of Operation:
- .1 General
- .2 Hot Water Heating System Heat Pump, Boiler and Heating Loop Controls
- .3 Hot Water Unit Heater and Cabinet Unit Heaters
- .4 In-Floor Radiant Heating
- .5 Rooftop Air Handling Unit
- .6 Washroom Exhaust Fans
- .7 Mechanical and Electrical Room
- .8 Animal Isolation Exhaust Fans
- .9 Graphical User Interface
- .10 Domestic Hot Water Boilers
- .11 Miscellaneous

1.3 SYSTEM DESCRIPTION

.1 This Section defines the manner and method by which controls function.
.2 Requirements for each type of control system operation are specified.
.3 Equipment, devices, and system components required for control systems are specified in other Sections.

1.4 SUBMITTALS FOR REVIEW

.1 Section 20 01 01:
.2 Shop Drawings: Indicate mechanical system controlled and control system components.
- .1 Label with settings, adjustable range of control and limits. Include written description of control sequence.
- .2 Include product data for each control system component.
- .3 Include flow diagrams for each control system, graphically depicting control logic.
- .4 Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

.3 Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 20 01 01: Submittals for project closeout.
.2 Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

1.6 QUALITY ASSURANCE

.1 Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the Province of Ontario.

2 EXECUTION

2.1 GENERAL

.1 Space sensors/thermostats located in public areas shall be vandal proof sensors only with set point adjustments from the operator work station.
.2 Coordinate control details with other trades and suppliers.
.3 The controls contractor shall be a subcontractor to the general contractor. Coordinate control details with other trades and suppliers.

2.2 HOT WATER HEATING SYSTEM HEAT PUMP, BOILER AND LOOP CONTROLS

.1 Enable the heating system when outside air temperature is below 18°C (adj.). The heating circulation pumps P-2A and P-2B are duty & standby. P-2A will be operated whenever the heating system is enabled. Pump status shall be monitored via a current sensor. If any pump fails, an alarm will be generated. If P-2A fails, P-2B will run. Running pump will alternate based on a 7-day schedule.
.2 Heat Pump circulating pump P-4 shall be wired to heat pump controller with a 5-minute delay off timer; pump status is monitored via a current sensor. Pump status shall be verified before starting heat pump. Cycle the heat pump to maintain supply water temperature of 120°F (49°C) (adj.), monitor the return water temperature.
.3 Whenever supply water temperature goes above high-water temperature limit, the heat pump shall be disabled.
.4 Electric boiler and associated circulating pump P-3 shall operate when heat pump is not able to operate due to outdoor temperature, or if leaving water temperature from heat pump requires additional heat injection.
.5 Provide a differential pressure sensor to control pump P-2A & P-2B speed, pressure set point is determined during TAB. Sensor shall be located 2/3rds of the way from pumps on longest developed length of piping.
.6 Alarms
    .1 High Water Temp: If supply water temperature is higher than the high limit set point (adj.).
    .2 Low Water Temp: If supply water temperature is lower than the low limit set point (adj.).
    .3 Heat Pump Failure: Commanded on, but the status is off.
    .4 Electric Boiler Failure: Commanded on, but the status is off.
    .5 Pump Failure: Commanded on, but the status is off. (applies to all circulating pumps)
    .6 High/Low loop pressure.

2.3 HOT WATER CABINET HEATERS AND UNIT HEATERS

.1 The cabinet heaters and unit heaters shall each be controlled by a remote wall mounted line voltage thermostat or built-in thermostat (as indicated on drawings) supplied by cabinet heater or unit heater manufacturer.

2.4 IN-FLOOR RADIANT HEATING

.1 In-floor radiant heating system manufacturer to provide control system and sensors for in-floor heating system. Controls contractor to provide alarm from in-floor heating system controller to BAS.
.2 Control zone valves to maintain the in-floor heating zone loop space temperature.
.3 The in-floor manifolds shall be equipped with motorized valve 24-volt actuators on each loop and the control contractor to connect control wiring to the appropriate control valves.
.4 The room occupancy mode (Occupied or Unoccupied) shall be determined by the weekly time schedule for the area.
    .1 Occupied Mode
        .1 The in floor manifold valve shall be energized to circulate water to maintain occupied space temperature set point as the first stage heating.
        .2 The valve shall remain closed when the room is in cooling mode.
        .3 When heating system is disabled, the valve shall remain closed.
    .2 Unoccupied Mode
        .1 Unoccupied Setback Heating: Open the valve till the space temperature is 2°F (1°C) degrees above the unoccupied space temperature heating set point.

.2 When outside air temperature is above 65°F (18°C) or heating system is disabled, the manifold valve shall remain closed.

.3 Alarms

.1 High Zone Temp: If the zone temperature is 5°F (3°C) greater than the cooling setpoint.

.2 Low Zone Temp: If the zone temperature is 5°F (3°C) less than the heating setpoint.

.3 High Loop Supply Water Temp: If the loop water temperature is above 130°F (55°C).

2.5 ROOFTOP HEAT PUMP AIR HANDLING UNIT (RTU-1)

.1 System consists of the following:

.1 Outside air damper
.2 Return air damper
.3 Exhaust air damper
.4 Pre-filters
.5 High efficiency filter
.6 Heat Pump
.7 Electric auxiliary heat
.8 Energy Recovery Wheel
.9 Supply fan c/w VFD
.10 Exhaust fan c/w VFD

.2 General Operation: Unit operates as a constant air volume system with heat recovery.

.3 Dedicated controller: AHU shall be controlled by a dedicated controller mounted adjacent to the unit/system.

.4 Indication & adjustments: All settings shall be operator adjustable via password protected access.

.5 Start/Stop: The unit shall be started and stopped by the BMS and shall run based upon an operator adjustable schedule at the OWS. The modes of operation shall be either occupied or unoccupied. The occupancy mode can be also overwritten by a network input.

.6 Optimum Start: The unit shall start prior to scheduled occupancy based on the time necessary for the zones to reach their occupied set points. The start time shall automatically adjust based on changes in outside air temperature and zone temperatures.

.7 Intake/Discharge/ Return Dampers: On start-up, intake and discharge damper shall be fully open. Return damper shall remain closed. When statuses are verified by damper end switches, the return fan shall start, with supply fan to follow. On shut down, damper shall close after 30 sec. (adj.) time delay after the fan stopped.

.8 Return/Exhaust Fan: The return/exhaust fan and associated VFD shall run anytime the unit is commanded to run. Return/Exhaust fan shall be energized prior to supply fan running. To prevent short cycling, the return/exhaust fan/VFD shall have a user definable (adj.) minimum runtime. The return/exhaust fan shall be interlocked (hard-wired) with return/exhaust dampers. The dampers shall open first as indicated in the sequence above.

.9 Supply Fan: The supply fan and associated VFD shall track the exhaust fan. To prevent short cycling, the supply fan/VFD shall have a user definable (adj.) minimum runtime. The supply fan shall be interlocked (hard-wired) with intake and discharge dampers. The dampers shall open first as indicated in the sequence above.

.10 Duct Pressure: Duct static pressure sensor shall modulate the supply fan VFD speed from 60% (adj.) to 100% (adj.) to maintain duct static pressure set point of 1.0" WC (adj.)

.11 Supply Air Temperature (Optimized): The controller shall monitor the supply air temperature and maintain supply air temperature set point of 23°C (adj.) in occupied mode and 21°C/25°C (adj.) (winter/summer) in unoccupied mode. The supply air temperature set point shall be reset based on zone cooling and heating requirements. The zone thermostats connected to the system shall be monitored and the zone requiring the lowest supply air temperature governs the reset of the supply air temperature. In cooling: as demand increases due to a rise in space temperature or humidity above their respective set points, the supply air set point shall incrementally reset down to 22°C (adj.), as demand decreases, set point shall incrementally reset up to 24°C (adj.). The controller shall monitor the air temperature (while in heating mode) and modulate the heat pump to maintain set point. The

controller shall also monitor the air temperature (while in cooling mode) and modulate economizer and the heat pump to maintain set point.

.12 Outdoor Air: OA damper shall modulate between minimum position and maximum position based on occupancy schedule and economizer.

.13 Temperature Control: The system will monitor the supply air temperature via a duct mounted sensor. The heat pump will be controlled in sequence to maintain the discharge air temperature setpoint, which can be reset from space temperatures.

.14 Cooling/Heating: The heat pump will be staged in sequence to maintain the space air temperature setpoint. Backup electric heater shall be energized when outdoor air temperature falls below heat pump operating temperatures.

.15 Defrost: heat pump shall reverse flow below OA temperature (determined by manufacturer) for defrost cycle.

.16 Economizer: The economizer dampers (outside air, return air & relief air dampers) shall have an independent control signal and damper actuator for each damper. The dampers shall be complete with auxiliary end switches. The economizer operation shall be enabled whenever the OSA enthalpy is less than the return air enthalpy and the fans are on. The mixed air temperature sensor shall modulate the economizer dampers in sequence from minimum position to full open position to maintain supply air temperature set point. The outside air damper shall maintain a minimum position equivalent to 30% outdoor air. A signal from the OWS shall override economizer damper position to the value determined at the OWS. The outside and exhaust air dampers close and the return air damper opens when the unit is off, air temperature drops below set point, the freezestat is on or when fans stop. If optimum start is initiated, the economizer dampers shall modulate to precondition the space with minimal energy expended whenever possible. Otherwise, outside air and exhaust air dampers shall close.

.17 Fire Conditions: The unit shall stop when a fire condition is relayed by a signal from the fire alarm system.

.18 Monitoring: The controller shall monitor:

- .1 Equipment Status: supply fan (thru CSR), return fan (thru CSR),
- .2 Temperature: mixed air, supply air, return air,
- .3 Differential Pressure: Pre filter, final filter,
- .4 Alarm Condition: freezestat, VFDs,

.19 Alarms: AHU alarms shall be routed to the OWS, pager, main switchboard and/or local printer as required. Alarms shall be provided as follows:

- .1 Supply / Return Fan Failure: Commanded on, but the status is off after 15 second delay,
- .2 Supply / Return Fan in Hand: Commanded off, but the status is on,
- .3 Supply / Return Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.),
- .4 Supply / Return Fan VFD Fault,
- .5 High / Low Supply Air Static Press: static pressure 25% (adj.) greater / 25% (adj.) less set point,
- .6 High / Low Supply Air Temp: supply air temperature greater / less than 90°F / 40°F (adj.),
- .7 High / Low Mixed Air Temp: mixed air temperature greater than 90°F (adj.) / less than 45°F (adj.),
- .8 High / Low Return Air Temp: return air temperature greater than 90°F (adj.) / less than 45° F (adj.),
- .9 Prefilter or final filter differential pressure exceeds 1.0" w.g. (pre-filter) and 2.0" w.g. (high efficiency filter),

.20 Shut Down: On shutdown, the fans stop, the inlet and discharge dampers, valves return to their fail-safe positions. The unit shall shut down and generate an alarm under the following conditions:

- .1 Emergency shutdown
- .2 High / Low Supply Air Temp
- .3 Freezestat
- .4 High/Low static shutdown
- .5 Fire alarm

2.6 ROOFTOP HEAT PUMP AIR HANDLING UNIT (RTU-2, RTU-3, RTU-4)

.1 System consists of the following:

- .1 Outside air damper

.2 Return air damper
.3 Exhaust air damper
.4 Pre-filters
.5 High efficiency filter
.6 Heat Pump
.7 Electric auxiliary heat
.8 Energy Recovery Wheel
.9 Supply fan c/w VFD
.10 Exhaust fan c/w VFD

.2 General Operation: Unit operates as a constant air volume system with heat recovery.

.3 Dedicated controller: AHU shall be controlled by a dedicated controller mounted adjacent to the unit/system.

.4 Indication & adjustments: All settings shall be operator adjustable via password protected access.

.5 Start/Stop: The unit shall be started and stopped by the BMS and shall run based upon an operator adjustable schedule at the OWS. The modes of operation shall be either occupied or unoccupied. The occupancy mode can be also overwritten by a network input.

.6 Optimum Start: The unit shall start prior to scheduled occupancy based on the time necessary for the zones to reach their occupied set points. The start time shall automatically adjust based on changes in outside air temperature and zone temperatures.

.7 Intake/Discharge/ Return Dampers: On start-up, intake and discharge damper shall be fully open. Return damper shall remain closed. When statuses are verified by damper end switches, the return fan shall start, with supply fan to follow. On shut down, damper shall close after 30 sec. (adj.) time delay after the fan stopped.

.8 Return/Exhaust Fan: The return/exhaust fan and associated VFD shall run anytime the unit is commanded to run. Return/Exhaust fan shall be energized prior to supply fan running. To prevent short cycling, the return/exhaust fan/VFD shall have a user definable (adj.) minimum runtime. The return/exhaust fan shall be interlocked (hard-wired) with return/exhaust dampers. The dampers shall open first as indicated in the sequence above.

.9 Supply Fan: The supply fan and associated VFD shall track the exhaust fan. To prevent short cycling, the supply fan/VFD shall have a user definable (adj.) minimum runtime. The supply fan shall be interlocked (hard-wired) with intake and discharge dampers. The dampers shall open first as indicated in the sequence above.

.10 Duct Pressure: Duct static pressure sensor shall modulate the supply fan VFD speed from 60% (adj.) to 100% (adj.) to maintain duct static pressure set point of 1.0" WC (adj.)

.11 Supply Air Temperature (Optimized): The controller shall monitor the supply air temperature and maintain supply air temperature set point of 23°C (adj.) in occupied mode and 21°C/25°C (adj.) (winter/summer) in unoccupied mode. The supply air temperature set point shall be reset based on zone cooling and heating requirements. The zone thermostats connected to the system shall be monitored and the zone requiring the lowest supply air temperature governs the reset of the supply air temperature. In cooling: as demand increases due to a rise in space temperature or humidity above their respective set points, the supply air set point shall incrementally reset down to 22°C (adj.), as demand decreases, set point shall incrementally reset up to 24°C (adj.). The controller shall monitor the air temperature (while in heating mode) and modulate the heat pump to maintain set point. The controller shall also monitor the air temperature (while in cooling mode) and modulate economizer and the heat pump to maintain set point.

.12 Outdoor Air: OA damper shall be set to 100% open during unit operation.

.13 Temperature Control: The system will monitor the supply air temperature via a duct mounted sensor. The heat pump will be controlled in sequence to maintain the discharge air temperature setpoint, which can be reset from space temperatures.

.14 Cooling/Heating: The heat pump will be staged in sequence to maintain the space air temperature setpoint. Backup electric heater shall be energized when outdoor air temperature falls below heat pump operating temperatures.

.15 Defrost: heat pump shall reverse flow below OA temperature (determined by manufacturer) for defrost cycle.

.16 Fire Conditions: The unit shall stop when a fire condition is relayed by a signal from the fire alarm system.

.17 Monitoring: The controller shall monitor:

.1 Equipment Status: supply fan (thru CSR), return fan (thru CSR),
.2 Temperature: mixed air, supply air, return air,
.3 Differential Pressure: Pre filter, final filter,
.4 Alarm Condition: freezestat, VFDs,

.18 Alarms: AHU alarms shall be routed to the OWS, pager, main switchboard and/or local printer as required. Alarms shall be provided as follows:
.1 Supply / Return Fan Failure: Commanded on, but the status is off after 15 second delay,
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.3 Supply / Return Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.),
.4 Supply / Return Fan VFD Fault,
.5 High / Low Supply Air Static Press: static pressure 25% (adj.) greater / 25% (adj.) less set point,
.6 High / Low Supply Air Temp: supply air temperature greater / less than 90°F / 40°F (adj.),
.7 High / Low Mixed Air Temp: mixed air temperature greater than 90°F (adj.) / less than 45°F (adj.),
.8 High / Low Return Air Temp: return air temperature greater than 90°F (adj.) / less than 45° F (adj.),
.9 Prefilter or final filter differential pressure exceeds 1.0" w.g. (pre-filter) and 2.0" w.g. (high efficiency filter),

.19 Shut Down: On shutdown, the fans stop, the inlet and discharge dampers, valves return to their fail-safe positions. The unit shall shut down and generate an alarm under the following conditions:
.1 Emergency shutdown
.2 High / Low Supply Air Temp
.3 Freezestat
.4 High/Low static shutdown
.5 Fire alarm

2.7 WASHROOM EXHAUST FAN

.1 Washroom exhaust fans shall run when occupancy sensor / light switch indicates washroom is occupied. Control by Division 23 and Division 26.

2.8 MECHANICAL & ELECTRICAL ROOM

.1 The unit heater, outside air damper, exhaust air damper and fan (as shown on drawings) shall be wired to a line voltage thermostat and controlled to maintain the room temperature set point of 85°F (adj.). On a heating call, unit heater fan shall run; On cooling call, dampers shall open and exhaust fan shall run.
.2 Motorized damper and actuator to be supplied and installed by Division 25. Damper install by Division 23. Line voltage thermostat supplied with unit heater.

2.9 DOMESTIC WATER SYSTEM

.1 Monitor domestic hot water supply temperature and alarm at 140°F (60°C) supply temperature.
.2 Monitor and control the domestic hot water recirculation pump to maintain 140°F (60°C) in the DHW heater tank.
.3 Monitor and alarm of failure of DHW Heaters.

2.10 GRAPHICAL USER INTERFACE

.1 All systems described in the sequences of operation shall be shown on the graphical user interface with the setpoints, actual values, current status, mode of operation, alarms, etc. as described in the individual sequences.

END OF SECTION

1 GENERAL

1.1 REFERENCES

.1 The General Conditions of the Contract, the Supplementary Conditions, and all Sections of Division 01 apply to and are a part of this Section of the Specification.

1.2 APPLICATION

.1 This Section specifies requirements that are common to electrical work Sections of the Specification, and it is a supplement to each Section and is to be read accordingly.

1.3 DEFINITIONS

.1 The following are definitions of words found in electrical work Sections of the Specification and on associated drawings:
- .1 “concealed” – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, underground, walls and partitions
- .2 “exposed” – means work normally visible, including work in equipment rooms and similar spaces
- .3 “provide” (and tenses of provide) – means supply and install complete
- .4 “install” (and tenses of install) – means install and connect complete
- .5 “supply” – means supply only
- .6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished
- .7 “governing authority” and/or “regulatory authority” and/or “Municipal authority” – means all government departments, agencies, standards, rules and regulations that apply to and govern the electrical work and to which the work must adhere
- .8 “Consultant” – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner
- .9 “O&M” – means Operating and Maintenance

.2 Wherever the words “indicated”, “shown”, “noted”, “listed”, or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is “indicated”, “shown”, “listed”, or “noted” on the drawings.

.3 Wherever the words “approved”, “satisfactory”, “as directed”, “submit”, “permitted”, “inspected” or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is “approved by”, “inspected by”, etc., the Consultant.

.4 In the electrical specification, singular may be read as plural, and vice-versa.

.5 “Owner”: means Building Owner as defined in the Contract or the Owner’s designated representative.

.6 “Wet”: means wet areas requiring special materials. Where indicated on drawings and/or specified herein. Includes but not limited to pools, whirlpools, showers, etc.

1.4 METRIC AND IMPERIAL MEASUREMENTS

.1 Both Metric and Imperial units of measurement are indicated in the electrical Specification.

1.5 EXAMINATION OF SITE AND DOCUMENTS

.1 When estimating the cost of the work and prior to submitting a bid for the work, carefully examine all of the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work, and include for all such conditions in the bid price.

.2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.

1.6 DRAWINGS AND SPECIFICATION

.1 Read the electrical work drawings in conjunction with all other structural, architectural, sprinkler, mechanical, etc., drawings and, where applicable, the Code Consultant's report.

.2 The electrical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.

.3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at no extra cost to this Contract, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.

.4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 3 meters (10 feet) in any direction without a change to the contract.

.5 Sections of the electrical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.

.6 The electrical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.

.7 The electrical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.

.8 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the most costly arrangement will take precedence.

.9 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the most costly arrangement will take precedence.

.10 Provide all products and methods mentioned or shown in the Contract documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.

1.7 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS

.1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions. Unless otherwise specified, the order of right-of-way for services is to be as follows:

- .1 piping requiring uniform pitch
- .2 piping 100 mm (4") dia. and larger
- .3 large air ducts (main runs)
- .4 electrical cable tray and bus duct
- .5 conduit 100 mm (4") dia. and larger
- .6 piping less than 100 mm (4") dia.
- .7 smaller branch ductwork
- .8 conduit less than 100 mm (4") dia.

.2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install conduit, cable tray, and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.

.3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to the electrical work.

.4 All outlet boxes, junction boxes, pullboxes, equipment and similar products, particularly such products located above suspended ceilings, must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

.5 Layout Drawings: Do not use the Contract Drawing measurements for prefabrication and layout of work. Locations and routing are to generally be in accordance with the Contract Drawings, however, layout drawings are to be prepared for all such work. Use established bench marks for both horizontal and vertical measurements. Coordinate with and make allowances for the work of other trades, accurately layout the work, and be entirely responsible for all work installed in accordance with layout drawings.

.6 Interference Drawings: Prepare dimensioned working interference drawings, supplementary to the Contract Drawings for all areas where multiple services and/or equipment occur, or where the work due to architectural and structural considerations requires special study and treatment. Review interference drawings with the Consultant before the work is installed. Where this Contractor's work has been installed in such areas without preparation of interference drawings and conflicts occur, revise this work to suit at no additional cost.

1.8 COORDINATION OF THE WORK

.1 Review all the Contract Documents and coordinate the work with the work of all subcontractors. Coordination requirements are to include, but not be limited to, the following:

.1 written notification of all concrete work such as housekeeping pads, bases, etc., required for electrical work, and including required dimensions, operating weight of equipment, location, etc.

.2 depth and routing of excavation required for electrical work, and requirements for bedding and backfill

1.9 QUALITY ASSURANCE

.1 All electrical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant's approval.

.2 All journeyman tradesmen are to have valid trade certificates available at the site for review by the Consultant at any time.

.3 An experienced and qualified superintendent is to be on-site at all times when electrical work is being performed.

1.10 EQUIPMENT AND MATERIALS

.1 Unless otherwise specified, all equipment and materials are to be new.

.2 All equipment is to be installed in accordance with the manufacturer's published instructions, unless specified otherwise in the specification or on the drawings.

.3 Where price, quality, and local service facilities are equivalent, preference will be given to products produced in the locality of the work or by producers located in the locality of the work. The decision as to the equality of products rests solely with the Owner.

1.11 EQUIPMENT AND MATERIAL MANUFACTURERS

.1 Equipment and materials selected, scheduled or specified on the drawings or in the specification have been selected to establish a performance and quality standard, and, in some cases, a dimensional standard for the Project. In most cases acceptable manufacturers are listed for any product specified by manufacturer's name and model number. Bid Prices shall include only products specified or approved equivalents. Contractors may propose unsolicited alternatives to the products specified. Alternative proposals shall be submitted in sealed envelope at time of General Contract Bid submission and shall include full description and technical data, and a statement of the related increase or decrease in Bid Price should alternatives be accepted. All additional costs associated with

unsolicited alternative proposals such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in the alternative proposals. Prior approval by consultant is not required for unsolicited alternative proposals.

.2 Where Contractor uses equipment other than that first named, on which the design is based, he shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in Bid Price.

.3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by first named manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the first named specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products, prepare and submit for review, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

.4 The Consultant will review and evaluate unsolicited alternatives and substitutions proposed by the Contractor. Such review and evaluation work will be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations. The Contractor shall also reimburse the Owner for any and all costs incurred in updating Contract Documents to reflect such changes.

1.12 ELECTRICAL SUPPLEMENTARY BID FORM

.1 Within 24 hours after award of a Contract, complete and submit to the Consultant for review, a completed Electrical Supplementary Bid Form to indicate the name of the manufacturer you propose to use for each item of equipment listed. If an acceptable manufacturer other than a first named specified manufacturer is listed for any product, ensure that the model number or series designation of the product is indicated so that the Consultant can determine its equivalency. If an alternate manufacturer is listed in the Electrical Supplementary Bid Form for any product, ensure that the model number or series designation of the product is indicated so that the Consultant can determine its equivalency.

.2 Any product manufacturers listed by the Contractor on the Electrical Supplementary Bid Form that are not named as acceptable, or any acceptable manufacturer's product which, in the opinion of the Consultant, does not meet equivalency criteria specified will be rejected and must be replaced with a suitable product.

.3 If the Electrical Supplementary Bid Form is not submitted within the time indicated above after award of a Contract, the products first named specified and scheduled by manufacturer's name and model number and on which the Project is based are to be supplied. No substitutions whatsoever will be accepted unless previously approved in writing by the Consultant.

.4 The Electrical Supplementary Bid Form is included as Section 26 00 01.

1.13 SUBSTITUTED OR ALTERNATIVE PRODUCTS

.1 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of ten (10) full working days prior to the bid closing date. Requests may be made by letter, by fax, or by email. Telephone requests will not be considered.

.2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.

.3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative or other than first named manufacturer. In addition, in

equipment spaces where substituted or alternative or other than first named products are used in lieu of the specified first named products and the dimensions of such products differ from the specified first named products, prepare and submit for review, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

.4 The Consultant's decision regarding any proposed substitution or alternative product is final.

1.14 CODES, REGULATIONS, AND STANDARDS

.1 All Codes, Regulations, and Standards referred to in this Section are the latest edition of the Codes, Regulations, and Standards in effect at the time of tendering this Project.

.2 All work is to be in accordance with requirements with Codes, Regulations, and Standards applied by governing authorities.

.3 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted. Pay all associated costs associated with these submittals.

.4 All electrical items associated with mechanical equipment are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

.5 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.15 WORKPLACE SAFETY

.1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain one copy at the site in a visible and accessible location available to all personnel.

.2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.

1.16 SHOP DRAWINGS AND PRODUCT DATA SHEETS

.1 Prior to supplying any products to the site, submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification.

.2 Prepare and submit one (1) electronic copy of shop drawings of major equipment items.

.3 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference, i.e. "Panelboard A", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.

.4 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure that this requirement is clearly indicated on the submission.

.5 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS" and include the company name, the submittal date, and the signature of an officer of the company to indicate your review and approval as above.

.6 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:

- .1 "Reviewed" or "Reviewed As Modified" to indicate that his review is final and no re-submittal is required
- .2 "Revise and Resubmit" to indicate that the submission is rejected and is to be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted

.7 The following is to be read in conjunction with the wording on the Consultant's review stamp applied to each and every electrical work shop drawing or product data sheet submitted:

.1 "This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."

.8 Provide draft copy of all manuals prior to expected date of completion of work for review by Owner.

.9 Prepare copies of all schematics for training purposes and submit to Owner for review 30 days prior to demonstration and training purposes.

1.17 CHANGES OR REVISIONS TO THE WORK

.1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity or type of any work from that required by the Contract Documents, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision.

.2 The Contractor's quotation is to be a detailed and itemized estimate of all product, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.

.3 The following requirements apply to all quotations submitted:

.1 when the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work

.2 material costs are not to exceed those published in local estimating price guides

.3 costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and must reflect the actual personnel performing the work

.4 the cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent's involvement is necessary

.5 costs for rental tools and/or equipment are not to exceed local rental costs

.6 Refer to the General Conditions of the Contract and all Sections of Division 01 for allowable percentages for overhead and profit.

.7 the overhead percentage will be deemed to cover all quotation costs other than actual site labour and materials, and rentals

.8 all quotations, including those for deleted work, must include a figure for any required change to the Contract time

.4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.

.5 If, in the Contractor's opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees a Notice of Change will be issued.

.6 Do not execute any change or revision until written authorization for the change or revision has been obtained.

1.18 NOTICE FOR REQUIRED FIELD REVIEWS

.1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect the work for deficiencies prior to Substantial Performance, for commissioning demonstrations, and any other such field review, give the Consultant adequate notice in writing.

.2 If the Consultant is unable to attend a field review when requested, arrange an alternative date and time.

.3 Do not conceal work until the Consultant advises that it may be concealed.

1.19 SCAFFOLDING, RIGGING, AND HOISTING

.1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for the work of this Division. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

.2 Do not place major erection loads on any portion of the structure without approval from the Consultant.

1.20 PROJECT CLOSEOUT SUBMITTALS

.1 Prior to application for Substantial Performance of the Project, submit all required documentation specified, including one (1) hard copy and one (1) electronic copy of the following:

- .1 Operating and Maintenance Manuals – to include testing and commissioning reports and ESA certificates.
- .2 as-built record drawings (PDF and CAD format) and associated data
- .3 identified keys for mechanical/electrical equipment and/or panels for which keys are required
- .4 other data or products specified

1.21 OPERATING AND MAINTENANCE MANUALS

.1 Submit, prior to application for Substantial Performance, 3 hard copies of operating and maintenance manuals consolidated in black hardcover 3 “D” ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently on binder spine with the Project name, “ELECTRICAL OPERATING AND MAINTENANCE MANUAL” wording, and the date. Manuals are to include the following:

- .1 Submit prior to application for Substantial Performance, one (1) PDF format and one (1) hard copy format clearly marked and labelled accordingly.
- .2 Ensure the binder spines have typewritten lettering as follows:

  OPERATION & MAINTENANCE MANUAL
  for

  OPERATION & MAINTENANCE MANUAL
  for
  Brantford Animal Shelter
  [Insert date of submission]
  [Insert Division Title]

- .3 a Table of Contents sheet, and corresponding index tab sheets. Use plastic tab indices for all sections of the manual with separate sections for each different type of equipment item.
- .4 a copy of each “Reviewed” or “Reviewed As Modified” shop drawing or product data sheet, with manufacturer’s/supplier’s name, telephone and fax numbers, email address, and the email address for local source of parts and service
- .5 operating data, which is to include:
  - .1 Description of each system and its controls
  - .2 System schematic wiring diagrams; mark correct operating settings for each device on these diagrams
  - .3 Operation instruction for each system and each component
  - .4 Description of actions to be taken in event of equipment failure; step by step procedure to follow in putting each piece of equipment into service.
  - .5 Drawings of each control panel completely identifying all components on the panels and their functions.
  - .6 Include Owner’s equipment numbers on all equipment submitted.
  - .7 Diagram of the electrical system indicating the wiring of all related electrical components such as fuses, interlocks, electrical switches and relays
- .6 Maintenance data, which is to include:
  - .1 manufacturer’s maintenance instructions, servicing maintenance, operation and trouble-shooting instructions for each item of equipment; list parts numbers and lists, name of supplier and maintenance and lubrication instructions

.2 schedules of tasks, frequency, tools required, and task time
.3 complete parts lists with numbers
.4 balancing and testing reports
.5 where fuses with maximum let-though current are indicated, provide manufacturer's fuse curve data in Operating and Maintenance Manuals showing fuse coordination with system interrupting capacity at that location in the system
.6 performance data, which is to include:
.1 equipment and system start-up data sheets
.2 equipment performance verification test results, and commissioning report

.2 Submit, prior to application for Substantial Performance, four digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document Format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to be copied to CDR with custom labels which indicate the project name, date, the Consultant's name, and "Operating & Maintenance Manual for Electrical Systems". Provide one additional digital version copy for Consultant's use.

1.22 RECORD "AS-BUILT" DRAWINGS

.1 Obtain PDF's from the Consultant for the production of record "AS-BUILT" drawings and pay for costs of reproduction and transmission costs. As work progresses at the site, clearly mark in red in a neat and legible manner on a set of white prints of the drawings, all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions. Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:
.1 the location of all work such as junction boxes and pullboxes concealed in inaccessible locations
.2 the locations of control devices with identification for each
.3 for underground work, record dimensions, invert elevations, all offsets, fittings, and locate dimensions from benchmarks that will be preserved after construction is complete
.4 the location of all concealed services terminated for future extension

.2 When work on site is complete, transfer all the as-built red line information from the site as-built drawings to a recordable and identified CAD disc with CAD work of equal quality to the Contract Drawings. Obtain a CAD disc as described below.

.3 The electrical drawings have been prepared on a computer aided drafting system. Obtain and pay for an electronic version of the drawings from the Consultant for use in producing final as-built drawings.

.4 Prior to inspection for Total Performance of the work, submit for review, the red line site as-built white prints, a CAD disc of the as-built drawings, and a bound set of white prints (of equal quality to the Contract Drawings) made from the disc. The Consultant will review the drawings and, if necessary, return the disc and the marked-up white prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the disc and white prints until they are determined to be acceptable.

1.23 PROGRESS PAYMENT BREAKDOWN

.1 Within 15 working days of written notification of award of contract submit a breakdown of the cost of the electrical work to assist the Consultant in reviewing and approving monthly progress payment claims.

.2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown is to include one time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, and project closeout submittals.

1.24 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

.1 All professional engineers retained by this Contractor to perform consulting services with regard to his work are to be members in good standing with the local Association of Professional Engineers, and

are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.

.2 This Contractor's retained engineer's professional liability insurance requirements shall be as indicated in the Division 0..

.3 Liability insurance requirements shall be as indicated in the Division 0.

1.25 GENERAL RE: INSTALLATION OF EQUIPMENT

.1 Unless otherwise specified all equipment is to be installed in accordance with the equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations.

.2 Ensure that proper access and code required service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded.

1.26 EXTENDED WARRANTIES

.1 All extended warranties specified in electrical work Sections of the Specification are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.27 CONTRACTOR'S MATERIAL AND TEST CERTIFICATES

.1 Submit Contractor's Material and Test Certificates for each system installed. Certificates shall include:
- .1 description of the system (designation and type),
- .2 description of the tests conducted and results observed, including re-testing where necessary,
- .3 description of any corrective measures undertaken,
- .4 description of materials used,
- .5 list of witnesses for each test conducted,
- .6 date system left ready for service,
- .7 signature of installing Contractor.

.2 Where certificates are prescribed by regulations, codes or standards, they shall conform to the requirements of those documents (eg. NFPA Standards, Electrical Safety Authority (ESA) Standards). A copy of each certificate shall be included in the Operating and Maintenance manuals.

1.28 PRODUCT DELIVERY, HANDLING AND STORAGE

.1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.

.2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

1.29 WARRANTY

.1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.

.2 Make submissions necessary to register product warranties to the benefit of the Owner.

.3 Submit to Consultant, prior to Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one year or offering greater benefits than required in specifications and in the Owner's name.

1.30 PROTECTION

.1 Protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under this Division.

.2 Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.

1.31 SERVICE CONNECTIONS

.1 Include in Bid Price all amounts required by municipality and/or Supply Authorities/ Utilities for service connections and/or modifications to service connections. Ensure amounts include fees, assessments, charges, etc., required in relation to service connection.

1.32 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

.1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete in accordance with the equipment/system manufacturer's instructions.

1.33 EQUIPMENT AND SYSTEM START-UP

.1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in electrical work Sections in accordance with the following requirements:

.2 Under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor.

1.34 EQUIPMENT AND SYSTEM COMMISSIONING

.1 After successful start-up and prior to Substantial Performance, commission the electrical work. Commissioning work is the process of the Contractor demonstrating to the Owner and Consultant, for the purpose of final acceptance by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operating and maintained to perform in accordance with requirements of the Contract Document, as further described below.

- .1 Operational Performance Testing: The Contractor is to test, adjust and operate components, equipment, systems and /or subsystems after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the Contract Documents, including all modes and sequences of control and monitoring, interlocks ,and responses to emergency conditions. The Contractor is to complete commissioning data sheets to document successful operational performance testing.
- .2 Functional Performance Testing: The Contractor is to repeat successful operational performance testing with complete commissioning data sheet documentation by the Contractor in the presence of the Consultant and Owner to validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
- .3 Submittals: The Contractor is to submit final commissioning data sheets, and other required submittals.

1.35 EQUIPMENT AND SYSTEM O & M DEMONSTRATION AND TRAINING

.1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.

.2 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in electrical work Sections of the Specification. All demonstrations and training is to be performed by qualified technicians employed by the equipment/system manufacturer/supplier.

.3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:

.1 Operational Requirements and Criteria: Requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, and limitations.

.2 Troubleshooting: Troubleshooting is to include but not be limited to diagnostic instructions, test and inspection procedures.

.3 Documentation: Documentation is to include but not be limited to equipment/system warranties, and manufacturer's supplier's parts and service facilities, telephone numbers, email addresses, and the like.

.4 Maintenance: Maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventative maintenance procedures, and use of any special tools.

.5 Repairs: Repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.

.4 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required

training material.

.5 Schedule demonstrations and training at mutually agreed to times with a minimum of seven working days notice.

.6 Training Session DVD: For equipment/system demonstration and training sessions as specified in electrical work Sections, submit an identified DVD of the session prepared by a professional photographer with construction project technical training session experience.

.7 Demonstration and Training Confirmation: Obtain from the Consultant, a list of personnel to receive demonstration and training, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

1.36 SPECIAL TOOLS AND SPARE PARTS

.1 Identify spare parts containers as to contents and replacement parts number.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers.

.3 Prepare a complete itemized list of special tools and spare parts and submit to consultant for review. List will be used as a checklist and should include provision for sign off by Owner on receipt.

2 PRODUCTS

Not Applicable

3 EXECUTION

Not Applicable

END OF SECTION

1 GENERAL

1.1 APPLICATION

.1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more electrical work Sections of the Specification, and it is intended as a supplement to each Section and is to be read accordingly.

1.2 SUBMITTALS

.1 Submit the following for review:
- .1 Product data sheets: submit for:
  - .1 Firestopping and smoke seal products
  - .2 Waterproofing seal assemblies
  - .3 Electrical work identification products
- .2 Sleeve and formed opening location drawings: upon notification of award of Contract begin to prepare accurately dimensioned drawings to locate all required electrical work sleeves, formed openings, and recesses in poured concrete work, and submit the drawings prior to concrete work commencing. Provide a copy of approved sleeving drawings to the reinforcement detailer well in advance of planned pours.
- .3 Access door locations: submit white prints of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations in walls and ceilings in finished areas
- .4 Samples: submit a sample of each proposed type of access door, and samples of materials and any other items as specified in electrical work Sections of the Specification
- .5 List of equipment nameplates: submit a list of equipment identification nameplates indicating proposed wording and sizes
- .6 Waste management and reduction plan: submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section
- .7 Additional submittals: submit any other submittals specified in this Section or other electrical work Sections of the Specification

2 PRODUCTS

2.1 SLEEVES

.1 Galvanized Sheet Steel: Minimum #16 gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.

.2 Polyethylene: Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

.3 Galvanized Steel Pipe – Waterproof: Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint.

.4 Galvanized Steel or Cast Iron Pipe: Schedule 40 mild galvanized steel pipe, or Class 4000 cast iron pipe, cut to length.

2.2 FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115 and CAN/ULC-S01 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding construction.

.2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.

.3 Multi-Cable Transits: UL/ULC listed and labelled multi-cable transits sized to the fire barrier opening and to suit the number of cables/conduits involved, and to provide a minimum two hour water-tight fire and smoke seal. Each assembly is to be complete with a stainless steel frame, cadmium plated

compression bolts, proper end packing, compression plates, steel stay plates, and fire rated neoprene insert blocks.

2.3 ESCUTCHEON PLATES

.1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the sleeve or building surface opening, and to fit tightly around the conduit or cable.

2.4 ACCESS DOORS

.1 Prime coat painted steel (unless otherwise specified) flush access doors, each complete with a minimum #16 gauge frame, minimum #18 gauge door panel, heavy-duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing features to suit the particular construction in which it is to be installed.

.2 Access door sizes are to suit the concealed work for which they are supplied, and wherever possible they are to be of a standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12” x 12”) for hand entry and 600 mm x 600 mm (24” x 24”) for body entry.

.3 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity.

.4 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout, and constructed of stainless steel with a #4 finish.

2.5 ELECTRICAL WORK IDENTIFICATION MATERIALS

.1 Equipment Nameplates: Minimum 3 mm (1/8”) thick 2-ply laminated, engraved, coloured plastic plates, minimum 12 mm x 50 mm (½” x 2”) for smaller items such as single phase starters and disconnect switches, minimum 25 mm x 65 mm (1” x 2½”) for equipment, and minimum 50 mm x 100 mm (2” x 4”) for panelboards and similar items. Additional requirements are as follows:

- .1 Unless otherwise specified or required, nameplates are to be white with black wording, except for emergency power system equipment nameplates which are to be red with white wording
- .2 Each nameplate is to be complete with bevelled edges and wording is to be as large as possible and completely identify the equipment and its use with no abbreviations
- .3 Wording is generally to be as per the drawings, i.e. LIGHTING PANEL A, and is to include the building area/zone served, but must be reviewed and approved by the Consultant prior to engraving
- .4 Supply stainless steel self-tapping screws for securing nameplates in place
- .5 Nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level

.2 Self-Adhesive Labels: Equal to Brother “P-Touch” or Thomas & Betts Canada Ltd. “EZCODE” Model EZL500 electronic labelling system self-adhesive labels with size and colour as directed, and permanently printed circuit identification nomenclature which is to be approved by the Consultant prior to producing the labels.

.3 Warning Signs: Equal to Thomas & Betts Canada Ltd. “BP” Series 250 mm x 355 mm (10” x 14”) semi-rigid vinyl signs with corner screw holes, the required printed wording (generally red on a white background with black trim) and pressure sensitive adhesive pads on the back.

.4 Conduit and Armoured Cable Identification: Equal to Brady Canada minimum 50 mm (2”) wide self-adhesive coloured vinyl tape.

.5 Conductor Terminations: Equal to Electrovert Ltd. slip-on “Z” type.

2.6 WALL MOUNTING EQUIPMENT BACKBOARDS

.1 Construction grade fir plywood, G1S, 20 mm (¾”) thick, with width and length as indicated on the drawings or as required for the equipment to be mounted. Each backboard is to be coated on all surfaces with a white flame retardant primer for a flame spread rating in accordance with Code requirements.

2.7 FASTENING AND SECURING HARDWARE

.1 Concrete Inserts: Zinc alloy cast-in-place or “wood-knocker” type formwork anchors for single or double runs of conduit, cable tray, etc,. and for equipment, and Unistrut Ltd. or equal multi type inserts for runs of three or more conduits, etc, or where a grid support system is required.

.2 Concrete Fasteners: Equal to wej-it Fastening Systems anchors or self-drilling anchors, or, for light loads, lead plugs and screws.

.3 Masonry Fasteners: Equal to wej-it Fastening Systems expansion shields and machine bolts, or, for light loads, lead plugs and screws.

.4 Gypsum Board Fasteners: Two-wing spring toggles, for light loads only.

.5 Structural Steel: Equal to Erico International Corp. “CADDY” beam clamps to suit the application.

2.8 ELECTRICAL ENCLOSURES

.1 Unless otherwise specified herein or on the drawings, NEMA, EEMAC, and CSA enclosures for transformers, switchgear, switchboards, panelboards, disconnect switches, starters, motor control centres, and similar equipment are to be as follows:

- .1 Indoor in high humidity/washdown areas – type 4 water-tight
- .2 Exterior – type 3R weather proof
- .3 Indoor in non-hazardous areas except as noted above – type 1

3 EXECUTION

3.1 GENERAL

.1 Manufacturer’s Instructions: For all materials and equipment, ensure that the manufacturers' installation instructions are followed unless otherwise specified herein or on the drawings, and unless such instructions contradict governing codes and regulations.

.2 Cleaning: Clean all conduit and equipment prior to installation. Temporarily cap or plug ends of conduits/ducts which are open and exposed during construction.

.3 Surfaces to Receive Your Work: Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.

.4 Repair of Finished Surfaces: For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.

.5 Work In High Humidity Areas: Where electrical work is located in high humidity areas or other “wet” areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on the products to protect against corrosion or provide products which will not corrode in the environment, i.e. galvanized hanger and support hardware, aluminium cable tray, etc.

.6 Accessibility: Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all junction boxes and pull boxes, and any other equipment which will or may need access, maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where boxes and similar conduit and conductor system accessories occur in vertical services in shafts, conduit/conductor spaces or partitions, locate the accessories at the floor level.

3.2 GENERAL CONDUIT & CONDUCTOR SYSTEM INSTALLATION REQUIREMENTS

.1 Unless otherwise specified, locate and arrange horizontal conduit and conductors above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained.

.2 Unless otherwise specified, install all conduit and conductors concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the

Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.

.3 Conduit and main distribution conductors may be exposed in electrical and mechanical rooms unless otherwise specified or indicated on the drawings or specified in the Specification.

.4 Install all exposed conduit and conductors parallel to building lines and to each other. Neatly group and arrange all exposed work.

.5 Do not install conduit and conductors within 150 mm (6") of "hot" piping or equipment unless the conduit and conductors are associated with the equipment.

.6 All conduit and conductors must be supported from the structure, not from ceiling hangers, piping, ductwork, cable tray, and similar mechanical or electrical products.

3.3 INSTALLATION OF SLEEVES

.1 Where conduits, round ducts, and armoured cables pass through concrete and/or masonry surfaces provide sleeves as follows:

.2 In poured concrete slabs, unless otherwise specified - minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves

.3 In concrete or masonry walls - Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe, cut to length

.4 Waterproof Sleeves: Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a water stop. Provide waterproof sleeves in the following locations:

- .1 In mechanical room floor slabs, except where on grade
- .2 In all floors equipped with waterproof membranes
- .3 In waterproof walls

.5 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around the conduit, duct, or cable.

.6 Pack and seal the void between the sleeves and the conduit, duct, or cable for the length of the sleeves as follows:

- .1 Fire rated construction: pack sleeves in fire rated construction as specified in the article below entitled "INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS"
- .2 Non-fire rated construction: pack sleeves in non-fire rated interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound
- .3 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified
- .4 Exterior walls below grade: seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below

.7 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.

.8 Terminate piping used for sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.

.9 "Gang" type sleeving will not be permitted.

.10 Where sleeves are provided for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of the sleeved opening. Where the sleeve is located in fire rated construction, ensure that the sleeve is sealed with firestopping material.

3.4 INSTALLATION OF WATERPROOF MECHANICAL SEALS

.1 Provide watertight link type mechanical seals for conduit, round ducts, and/or conductors through exterior wall openings where shown and/or specified.

.2 Assemble and install each mechanical seal in accordance with the manufacturer's instructions.

.3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

3.5 RECTANGULAR OPENINGS

.1 Openings for cable tray, multiple conduits and/or cables and similar rectangular openings will be provided in poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.

3.6 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Where electrical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 and CAN/ULC-S101-M to seal the penetrations.

.2 Work is to be performed only by a specialist company using tradesmen experienced in firestopping and smoke seal work.

.3 When firestopping and smoke seal work is complete, obtain from the specialist firm who performed the work a letter certifying that all required firestopping and smoke seal work has been completed in strict accordance with requirements of the Building Code, ULC requirements, any other applicable local Municipal Codes or Regulations, and the instructions of the firestopping and smoke seal manufacturer. Submit the letter to the Consultant.

3.7 INSTALLATION OF CABLE AND CONDUIT TRANSITS

.1 Provide fire rated UL/ULC listed transits in rectangular openings in fire rated slabs and walls where cable tray or multiple conduits, ducts, and/or cables penetrate the fire barrier

3.8 INSTALLATION OF ESCUTCHEON PLATES

.1 Provide escutcheon plates suitable secured over all exposed conduit, duct, and armoured cable passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.

.2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate is to fit tightly around the sleeve.

3.9 INSTALLATION OF FASTENING AND SECURING HARDWARE

.1 Provide all fastening and securing hardware required for electrical work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.

.2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components.

.4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CSA Standards CAN3-Z166.1 and 2.

.5 Do not attach fasteners to steel deck without written consent from the Consultant.

3.10 SUPPLY OF ACCESS DOORS

.1 Supply access doors to give access to all electrical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on the drawings.

.2 Locate access doors as inconspicuously as possible in walls and partitions and arrange electrical work such that it is clearly within view and accessible for inspection and servicing, and to suit access door locations shown on the reviewed and approved white prints of reflected ceiling plan and elevation drawings submitted as per Part 1 of this Section.

.3 Group work wherever possible to ensure the minimum number of access doors is required. Access

doors will be installed by the trades responsible for the particular type of construction in which the doors are required.

.4 Submit a sample of each proposed access door for review prior to ordering.

Ref. article 3.11. Read carefully and edit to suit the project.

1.1 ELECTRICAL WORK IDENTIFICATION

.1 General: The following requirements apply to electrical work identification:

- .1 The size and wording of identification nameplates must be approved by the Consultant prior to manufacture. Provide shop drawings of all nameplates and labels for review and comment
- .2 Identification wording for equipment is to follow drawing nomenclature for the equipment, unless otherwise specified
- .3 Secure nameplate to equipment with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces
- .4 Locate equipment nameplates in the most conspicuous and readable location
- .5 For multi-cell or multiple component equipment, provide a main nameplate and a smaller nameplate for each component to identify its name and service
- .6 Colour code: comply with OESC-4-036.

.2 Distribution Equipment: Provide identification nameplates for new each piece of equipment, including items such as substations, switchgear, switchboards, distribution panels, and similar products. Identification to include registration plates, ULC and CSA approvals, size, equipment model, manufacturers name, serial number, voltage, phase.

.3 Terminal Cabinets, Pull Boxes, Junction Boxes, Etc.: Clearly identify main pull and junction boxes by spray painting the outside surface of the covers. Paint colours are to be as specified below for conduit and conductor identification. For communication systems, i.e. intercom, TV, etc., provide a nameplate on the painted cover to identify the system involved.

.4 Transformers: Provide a nameplate to identify the transformer, its capacity, and primary and secondary voltages. Include ULC and CSA approvals, equipment model, manufacturer's name, serial number.

.5 Branch Circuit Panels: Provide a nameplate to identify the panelboard, the source from which it is fed, and the voltage, and provide identification labels for each circuit breaker.

.6 Motor Starters and Disconnect Switches: Provide a nameplate for each motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter supplied by this Division, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of the mechanical work. Nameplates are to identify the equipment being controlled, and the voltage.

.7 Lighting Switches and Receptacles: Unless otherwise specified identify the source panel and circuit number by means of an identification label applied to the wall above the device and inside the outlet box for each device.

.8 Warning Signs: Provide appropriately worded warning signs, secured with stainless steel screws or similar stainless steel hardware, in locations as follows:

- .1 On all doors into electrical rooms

.9 Conduit & Cable: Colour code conduit and armoured cable by means of 25 mm (1") wide primary colour plastic adhesive backed tape or neatly applied suitable paint with, where scheduled, a 20 mm (¾") wide auxiliary colour at points where the conduit or cable enters a wall, ceiling or floor, at least once in each room or accessible ceiling space, at each access door location, and elsewhere at maximum 15 m (45') intervals. Unless otherwise specified herein or on the drawings, colours are to be as follows:

SERVICE	PRIMARY COLOUR	SECONDARY COLOUR
Up to 250 volts	Yellow	
Up to 600 volts	Yellow	Green
Telephone	Green	
Other communication systems	Green	Blue

Fire Alarm	Red	
Security Systems	Red	Yellow

.10 Wire and Cable Terminations: Identify both ends of wire and cable terminations with the same unique number. Where numbers are not indicated or specified, assign a number and record them.

.11 Hospital Circuits: For dedicated circuit receptacles in critical care and intermediate patient care areas, in addition to requirements specified above, provide engraved “Dedicated Circuit” nameplates on the device faceplates, or, provide faceplates with engraved identification. For corridor 20 ampere housekeeping receptacles, provide engraved “20A Housekeeping” nameplates on the device faceplates.

3.11 INSTALLATION OF TERMINAL BACKBOARDS

.1 Provide suitably sized, identified, painted 19 mm (3/4”) GIS plywood backboards for wiring terminals where shown and/or specified and/or required.

.2 Wall mount the backboards and secure in place with stainless steel screws.

EDIT NOTE: Ref. article 3.13. Use only if the client insists that exposed conduit, conductors, equipment, etc., is to be finish painted as part of the electrical work and not part of the work of the painting section. If this is the case, ensure that the extent of finish painting and colours involved is specified or scheduled.

3.12 FINISH PAINTING OF ELECTRICAL WORK

.1 Refer to Division 09

3.13 GENERAL ELECTRICAL WORK TESTING

.1 In addition to tests required by Codes and Regulations, or tests specified in other electrical work sections of the specification, perform the following:

- .1 After all luminaires, switches, receptacles, motors, signals, and similar electrical items are installed, whether as part of the electrical work or as part of the work of other sections of the specification (telephone system excepted), test all work to ensure that there are no grounds or crosses
- .2 Establish proper motor rotation, measure full load running currents, and check overload elements, and report any discrepancies to the Consultant
- .3 Demonstrate to the Consultant that branch circuit voltage drop is within specified limits
- .4 Ensure that all devices are commissioned and operable

3.14 BRANCH CIRCUIT BALANCING

.1 Connect all branch circuits to panelboards so as to balance the actual loads (wattage) to within 5%. If required, transpose branch circuits to achieve this requirement.

.2 When requested by the Consultant, and after the building is occupied, perform tests to demonstrate that branch circuit balancing has been achieved.

3.15 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

.1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment is to be done as part of the electrical work:

EDIT NOTE: Ref. subparagraphs below. Coordinate with the mechanical engineer/designer and edit to suit the project.

- .1 “Line” side power wiring to motor starters or disconnects, and “load” side wiring from the starters or disconnects to the equipment
- .2 “Line” side power wiring to pre-wired power and control panels and variable frequency drives, and “load” side power wiring from the panels and VFD’s to the equipment
- .3 Provision of receptacles for plug-in equipment
- .4 Provision of disconnect switches for all motors that are in excess of 9 m (29.5’) from the

starter location, or that cannot be seen from the combination disconnect/starter location, and all associated power wiring. Reduce distance to 3m (9.8') for air conditioning or refrigeration equipment,

.5 All motor starter interlocking in excess of 24 volts

.6 Wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts

.7 Provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work

.8 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers

.9 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units

.10 120 volt wiring connections to duplex receptacles integral with air handling unit control panels

.11 120/208 volt wiring connections to electric heating units integral with air handing units.

.2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work will be done as part of the mechanical work.

EDIT NOTE: Ref. article 3.17. Delete this article if shut-down requirements for existing electrical systems are specified in Division 1, and/or the electrical work Demolition and Revision Work Section is issued.

3.16 EQUIPMENT BASES, SUPPORTS AND CURBS

.1 Concrete Housekeeping Pads: Unless otherwise specified or required, set all floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of the equipment on each side and end, or a minimum of 200 mm (8") from the centreline of equipment anchor bolts to the edge of the base, whichever is larger. Conform to the following requirements:

.1 Supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads

.2 Place anchor bolts during the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment

.3 As a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details

.2 Structural Steel Stands/Supports: For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to the following requirements:

.1 All stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review

.2 All steel stands are to be flange bolted to concrete housekeeping pads

.3 Access Platforms and Miscellaneous Steel Work: Provide welded, cleaned and prime coat painted structural steel platforms where shown for service access to electrical equipment. Access platforms are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed shop drawings with calculations are to be submitted as shop drawings for review. Service access platforms are to conform to the following requirements:

.1 Platforms are to be in accordance with OSHA requirements and are to be adequately sized, braced, anchored, and, as required, seismically restrained

.2 Flooring is to be Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), or equal, welded steel bar type grating

.3 Support legs are to be welded Schedule 40 black steel pipe with welded steel cross-bracing, securely anchored and sway braced

.4 Safety guard rails, constructed from minimum 32 mm (1¼") dia. Schedule 40 black steel pipe are to be provided for all platforms and are to be complete with vertical stanchions at maximum 1.2 m (48") centres, top and intermediate horizontal railing, and toe plates at the floor

.5 Vertical ladders are to be constructed of Schedule 40 black steel pipe, 25 mm (1") dia. for equal height rungs, 40 mm (1½") for stringers, anchored to floors and walls and sway braced

as required

.6 Ships ladders, which are to used wherever space conditions permit, are to be of welded steel construction, are to climb at an approximate 60E angle, and are to be complete with channel iron stringers, open grate equal height risers approximately 165 mm (6½") wide and factory made by the grating manufacturer, handrails, and suitable anchoring and support

.4 Equipment Curbs

.1 Provide 100 mm (4") high concrete curbs around all openings through floors for electrical and system risers. Ensure joint between curb and floor is watertight and maintains integrity of floor membrane where applicable.

3.17 CONCRETE WORK FOR ELECTRICAL EQUIPMENT BASES/PADS, DUCT-BANKS, LIGHTING STANDARD BASES

.1 Provide all poured concrete work, including reinforcing and formwork, required for electrical equipment bases/pads, duct-banks, lighting standard bases and all miscellaneous services as shown. Perform concrete work in accordance with requirements specified in Division 3.

.2 Concrete is to be minimum 20,700 kPa ready-mix concrete in accordance with CAN/CSA-A23.1 and the Building Code.

.3 Submit for review, dimensioned shop drawings for all concrete pads or bases for support of large, heavy equipment. Indicate on the shop drawings the total weight of the pad or base as well as the equipment it is provided for, and concrete reinforcing. Shop drawings are to be prepared and stamped by a professional structural engineer registered in the place of the work.

3.18 EXCAVATION AND BACKFILL WORK

.1 Excavation, backfill and related work such as dewatering required for electrical work will be performed as part of the work of Division 02, except for final hand grading work which is to be done as part of the electrical work.

.2 Accurately mark-out the location and routing of excavation required for your work, as well as the required depth.

.3 Ensure that all underground electrical work has the proper amount of cover.

3.19 EXCAVATION AND BACKFILL WORK

.1 Provide all excavation, backfill and related work required in execution of work under this Division. Perform such work in accordance with requirements of Division 02, except as modified by this Article. Obtain a copy of the soil test report and review during the bidding period.

.2 Grade the bottom of trench excavations as required.

.3 In firm, undisturbed soil, lay duct, conduit, etc., directly on the soil, unless otherwise directed.

.4 Unless otherwise specified, backfill trenches within the building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of the work. Hand or machine compact the balance up to grade.

.5 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the duct/conduit, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.

.6 Unless otherwise specified, backfill trenches outside the building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.

.7 The location and inverts of existing underground site services shown on the drawings are based on available information and are assumed to be correct, however, prior to excavation, carefully check inverts and locations and report any serious discrepancy, and contact Utilities to accurately locate their services.

.8 The Contractor will be held responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.

.9 Ensure that all underground work has the proper amount of cover.

3.20 CUTTING, DRILLING, AND PATCHING FOR ELECTRICAL WORK

.1 Provide all cutting, drilling and patching of the building for the installation of the work. Perform all cutting and drilling with proper tools and equipment. Confirm the exact location of cutting and drilling with the Consultant prior to commencing the cutting and/or drilling work.

.2 Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.

.3 Where new conduits, conductors, etc., pass through existing construction, core drill an opening. Size openings to leave 12 mm (1/2") clearance around the conduit conductor, etc.

.4 Prior to drilling or cutting an opening in poured concrete construction, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X-ray or Ferro Scan test the walls or slabs required.

.5 The contractor will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of this cutting or drilling work.

.6 Where drilling is required in waterproof slabs, size the opening to permit snug and tight installation of a sleeve which is sized to leave 12 mm (1/2") clearance around the conduit, duct, etc. Provide a sleeve in the opening. Sleeves are to be Schedule 40 galvanized steel pipe with a flange at one end and a length to extend 100 mm (4") above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.

.7 Ensure that cutting and patching of roofs and reinforced concrete structures is executed by specialists familiar with the materials affected, and is performed in a manner to neither damage nor endanger the work. Coordinate and supervise such cutting and patching.

3.21 PACKING AND SEALING CORE DRILLED OPENINGS

.1 Pack and seal the void between the conduit, conductor, etc., opening and the conduit, conductor, etc., for the length of the opening as follows:

- .1 non-fire rated interior construction: pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal
- .2 Fire rated construction: pack and seal openings in fire rated walls and slabs as specified in this Section
- .3 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified
- .4 Exterior walls below grade: seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below

3.22 FLASHING FOR ELECTRICAL WORK PENETRATING THE ROOF

.1 Provide all required flashing work, including counter-flashing, for electrical work penetrating and/or set in the roof.

.2 Perform flashing work in accordance with requirements of drawing details, and requirements specified in Division 07.

3.23 INSTRUCTIONS TO OWNER

.1 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of electrical systems and equipment, on two separate occasions.

.2 Arrange and pay for the services at the site, for the length of time required, of qualified technicians and other manufacturer's representatives to instruct on specialized portions of the installation.

.3 Ensure each instruction period includes, but is not limited to the following;

- .1 A classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,
- .2 Instruction during the classroom seminar by the manufacturer's representative regarding the

proper operating and maintenance procedures for each item of equipment,
.3 Demonstration of the proper operating procedures for each item of equipment,
.4 Explanation of the purpose and function of all safety devices provided,
.5 Demonstration of all measures required for safe and proper access for operation and maintenance.

.4 Provide a period of follow-up instruction (on two occasions) approximately one month after completing Owner's instruction to clarify and reinforce earlier instructions.

.5 Submit, prior to Substantial Performance, a complete list of systems for which instructions where given, stating for each system:
.1 Date instructions were given to the Owner's staff
.2 Duration of instruction
.3 Names of persons instructed
.4 Other parties present (manufacturer's representatives, etc.)

.6 Obtain the signatures of the Owner's staff to verify they properly understood the system installation, operation and maintenance requirements and have received operating and maintenance manuals and record drawings.

3.24 CLEANING ELECTRICAL WORK

.1 Refer to cleaning requirements specified in Division 01.
.2 Clean all electrical work prior to application for Substantial Performance of the work.

3.25 USE OF ELECTRICAL SYSTEMS FOR TEMPORARY POWER AND LIGHTING

.1 Provide temporary power and lighting during construction.
.2 Each entire system is complete, tested, and commissioned.
.3 energy costs are to be paid by the Contractor.

3.26 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

.1 Maintain all equipment in accordance with the manufacturer's printed instructions prior testing and commissioning.

3.27 CONNECTIONS TO OTHER EQUIPMENT

.1 Carefully examine the Contract Documents during the bidding period and include for electrical work connections to equipment requiring such connections.

3.28 EQUIPMENT AND SYSTEM COMMISSIONING

.1 Commissioning shall conform to the following standards:

.2 CAN/CSAZ318.0-05 (R1999) Commissioning of Health Care Facilities The Commissioning Team shall be comprised of:
.1 Representatives of the Commissioning Coordinator (commissioning Agent)
.2 The individual, company or agency undertaking the work of each Section,
.3 Representatives of the Contractor and his sub-contractors as required,
.4 Representatives of equipment manufacturers,
.5 Representatives of the Consultants,
.6 Representatives of the Owner.

.3 Prior to Substantial Performance, test, adjust, and commission the electrical work. Commissioning work is the process of the Contractor demonstrating to the Owner and Consultant, for the purpose of final acceptance, by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of the Contract Documents, as further described below.
.1 Operational Performance Testing: the contractor is to test, adjust and operate components, equipment, systems and/or subsystems after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in

accordance with requirements of the contract documents, including all modes and sequences of control and monitoring, interlocks, and responses to emergency conditions

.2 Functional Performance Testing: The Contractor is to repeat successful operational performance testing with documentation by the Contractor in the presence of the Consultant and Owner to validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.

.3 Submittals: The Contractor is to submit final commissioning reports, project closeout documents, and other required submittals.

3.29 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with requirements specified in Division 01.

.2 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.

.3 Place materials defined as hazardous or toxic waste in designated containers.

.4 Ensure emptied containers are sealed and stored safely for disposal.

3.30 REQUIREMENTS FOR BARRIER FREE ACCESS

.1 Include for all applicable requirements for barrier free access in accordance with requirements of the OBC, whether shown on the drawings or not.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 26 03 00.

1.2 WORK INCLUDED

.1 This Section provides minimum acceptance requirements for seismic restraints for all electrical equipment, raceways and conduit systems.

1.3 RELATED WORK SPECIFIED ELSEWHERE

.1 Concrete work is provided in Division 3.
.2 Concrete Floating Floors are specified in Division 3.
.3 Flexible conduit connections are specified elsewhere in Division 26.

1.4 QUALITY ASSURANCE

.1 Unless otherwise directed by the local authority having jurisdiction, the following codes and standards will apply:
  .1 Canadian Electrical Code
  .2 Ontario Building Code

1.5 SUBMITTALS

.1 All vibration isolation and seismic restraint systems shall be by one manufacturer. Basis of this design is Vibro-Acoustics
.2 Submit shop drawings for all devices specified herein and as indicated on the drawings. Submittals shall include dimensions, materials, attachment and anchorage requirements. Indicate compliance with each specification item herein.
.3 Provide calculations for selection of seismic restraints, certified by a qualified professional engineer licensed in the province where the project is located.
.4 Shop Drawings:
  .1 Provide detailed drawings of all seismic control measures for equipment, duct, and piping.
  .2 Provide separate shop drawings for each isolated system complete with performance and product data, indicating all calculations for loads and deflections.
  .3 Indicate inertia bases and locate vibration isolators, with static and dynamic loads on each.
  .4 Shop drawings shall include engineering calculations for all seismic restraints and attachment. A Professional Engineer registered in the province of the project shall sign, seal and date the calculations.
.5 Product Data: Provide schedule of vibration isolator type with location and load on each.
.6 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
.7 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed design requirements.

1.6 SEISMIC DESIGN CRITERIA

.1 For post-disaster buildings:
  .1 Importance factor for wind load, IW, is 1.0
  .2 Importance factor for earthquake loads and effects, IE, is 1.0
.2 Site classification for seismic site response is D
.3 Climatic and Seismic Data from the Ontario Building Code for specific location:

Location	Sa(0.2)	Sa(1.0)	q (1/50)
Brantford	0.19	0.061	0.42

.4 Terms:

.1 Sa(0.2): Spectral response acceleration for short periods.
.2 Sa(1.0): Spectral response acceleration for 1-second periods.
.3 q(1/50): The reference hourly wind velocity pressure in kPa.

1.7 PROJECT RECORD DOCUMENTS

.1 Record actual locations of seismic restraints including attachment points.

1.8 SEISMIC ENGINEER

.1 Professional Engineer holding a Certificate of Authorization in the Province of Ontario with a minimum of 5 years' experience in seismic design, and a minimum of $1 million Professional Liability Insurance including Errors and Omissions Insurance.
.2 A common seismic engineer shall provide seismic design, vibration isolation, and seismic restraint. Coordinate with Section 26 47 95.
.3 At the completion of the project, the Seismic Engineer shall review the installations on site, and shall prepare a written report, with a letter signed, sealed and dated by the Seismic Engineer, certifying that the installations have been completed in accordance with their design and shop drawings.

1.9 SEISMIC CONTROL MEASURES

.1 Seismic restraints are to be provided for all operational and functional components of building services in accordance with current requirements of the Ontario Building Code.
.2 Cable restraint systems, rod stiffener clamps and seismic isolator capacities shall be verified by an independent test laboratory.
.3 Connection materials shall be selected by and site-specific designs to be prepared by the Seismic Engineer. The Seismic Engineer may select and specify materials and anchors to be provided by the contractor where this is appropriate.
.4 Contractor shall ensure that the Seismic Engineers' requirements and specification are met.

2 PRODUCTS

2.1 SEISMIC AND WIND RESTRAINTS

.1 Vibration isolators with integral seismic restraint: Floor mounted isolators shall meet the requirements as listed above. For those devices intended to provide restraint from seismic and wind forces, housings shall be capable of withstanding the applicable design forces for the specific installation.
    .1 Seismic Spring Floor Mounts: Type SFS - Laterally stable, restrained spring type with support plate for bolting to the equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a neoprene noise isolation pad, minimum 6 mm (0.25") thick, bonded to the base plate. Mount shall include integral all-directional limit stops with elastomeric grommets preventing metal-to-metal contact and with minimum 3 mm (1/8") clearance under normal operation.
    .2 Seismic Restrained Spring Isolator: Type SCSR - Laterally stable, restrained spring type with housings and heavy top plates for supporting the equipment and resisting seismic and wind loading. Housings shall be of welded steel construction and include vertically restraining limit stops. Maximum clearance around the restraining bolts shall be 6 mm (0.25"). Top plate and restraining bolts shall be out of contact with the housing during normal operation and neoprene grommets shall be incorporated to minimize short-circuiting of restraining bolts.
    .3 Seismic Restrained Neoprene Mount: Type SRD - Neoprene type, including steel baseplate with mounting holes for anchors. Isolator shall include levelling and restraining bolt for mounting to the equipment and prevent metal-to-metal contact of the restraining bolt to the baseplate.
.2 Seismic Cable Restraints: Type SRK - Seismic cable sway bracing restraints shall consist of 7x19 galvanized steel aircraft cable sized to resist seismic loads with a safety factor of five (5). Cable end connections shall use heavy brackets, thimbles, and wire rope clips or compression sleeves.
.3 Hanger Rod Stiffener: Structural steel angle attached with a formed steel clamp to threaded rod

support.

.4 Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications.

.5 Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications.

3 EXECUTION

3.1 GENERAL

.1 Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint devices. Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchor bolts to avoid housekeeping pad breakout failure.

.2 Coordinate locations and sizes of structural supports with locations of seismic restraints (e.g., transformers, load banks, engine-generator sets, etc.).

3.2 SEISMIC RESTRAINT

.1 General:

.1 Provide restraint devices as required for isolated and non-isolated equipment. Provide positive seismic and wind restraints on those systems and components required by the applicable building code and by the local authority having jurisdiction.

.2 All bus duct, conduit, cable tray, and equipment shall be restrained to resist seismic forces per the applicable building code(s) as a minimum. Additional requirements specified herein are included specifically for this project.

.3 Install seismic restraint devices per the manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.

.4 Unless otherwise directed, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

.5 Provide hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.

.6 Refer to Federal Emergency Management Agency manual 413 for additional guidance on typical seismic restraint installation practices.

.2 Concrete Anchor Bolts

.1 Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

.2 Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

.3 Mechanical Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

.4 Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

.5 Set anchors to manufacturer's recommended torque, using a torque wrench.

.3 Equipment Restraints:

.1 Install adequate restraint for non-isolated equipment, substantiated by engineering calculations

.2 Install seismic snubbers on electrical equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and attach to equipment base and supporting structure as required. Alternatively, provide vibration isolators with seismically-

rated restraint housings.

.3 Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm)

.4 Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

.4 Cable Tray Systems:

.1 Seismically restrain all cable trays listed below, using seismic cable restraints:

.1 All cable trays carrying fire alarm, telephone, or other communication cabling, or life safety system control wiring that may be used in the event of an emergency.

.2 Any cable tray which if it were to fail would result in damage to a piece of equipment or building function that is or is related to a life safety function.

.3 Any cable tray whose accumulated weight (including design load for wiring) is equal to or greater than 146 N/m (10 lbs/ft).

.2 Space lateral supports a maximum of 9 m (30') o.c., and longitudinal supports a maximum of 18 m (60') o.c.

.3 Brace a change of direction longer than 3.7 m (8') and locate restraints within 0.6 m (2') of the direction change or end of cable tray.

.4 Install restraint cables so they do not bend across edges of adjacent equipment or building structure.

.5 Bus Duct and Conduit Systems:

.1 Seismically restrain all bus duct and conduits listed below, using seismic cable restraints:

.1 All bus ducts and conduits carrying fire alarm, telephone, or other communication cabling, life-safety system control wiring or power wiring serving critical equipment that may be used in the event of an emergency.

.2 Conduits greater than 65 mm (2.5") inside diameter or, if more stringent, in compliance with local code standards.

.3 Any trapeze support with multiple conduits or bus duct whose accumulated weight (including design load for wiring) is equal to or greater than 146 N/m (10 lbs/ft).

.4 Any bus duct or conduit that is deemed critical and must remain functional at the conclusion of a seismic event except as exempted by code requirements.

.5 Any bus duct or conduit, if it were to fail, would result in damage to a critical piece of equipment or building function.

.2 For supports with multiple conduits (trapezes), secure conduits to trapeze member with clamps approved for application.

.3 Space lateral supports a maximum of 12 m (40 feet) o.c., and longitudinal supports a maximum of 24 m (80 feet) o.c.

.4 Brace a change of direction longer than 3.7 m (8') and locate restraints within 0.6 m (2') of the direction change.

.5 Install restraint cables so they do not bend across edges of adjacent equipment or building structure.

.6 Install flexible conduit loops in conduits which cross building seismic joints, sized for the anticipated amount of movement.

.7 Install flexible conduits where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.3 INSPECTION AND CERTIFICATION

.1 After installation, arrange and pay for the seismic restraint product manufacturer to visit the site to verify that the seismic restraint systems are installed properly, and shall submit a certificate so stating.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Test Reports: Submit signed test reports for all testing work specified.
.2 Approval Certificates: Submit Certificates of Approval as issued by governing authorities.

2 PRODUCTS

Not applicable.

3 EXECUTION

3.1 GENERAL ELECTRICAL WORK TESTING REQUIREMENTS

.1 Satisfactorily perform all testing required by governing authorities, Codes, Regulation, and the Specification, including general testing specified below. Prepare and sign test reports to confirm satisfactory completion of testing and submit as specified in Part 1 of this Section.
.2 Perform testing to suit phasing of the work, as applicable.
.3 Leaks, Grounds, and Crosses: After luminaires, switches, receptacles, motors, signals, and similar equipment has been installed, whether or not the work has been installed as part of the work of this Division of the Specification or by other Divisions (telephone system excepted), test the work to ensure that there are no leaks, grounds, or crosses.
.4 Branch Circuit Voltage Drop: Demonstrate to the Consultant that branch circuit voltage drop is within specified limits.

3.2 GROUNDING AND BONDING SYSTEM

.1 Provide visual and mechanical inspection of the grounding and bonding system and verify that the system is in compliance with all requirements.

3.3 DISTRIBUTION SYSTEM TESTING AND COORDINATION STUDY

.1 Appoint and pay for independent inspection and testing consultant specializing in this work to carry out a complete coordination study of primary and secondary power distribution to verify proposed load shedding arrangements,] and to perform on-site pre-service inspection, testing of electrical equipment, and any other witness tests as required by governing authorities. Prior to appointment of testing consultant obtain approval of Consultant as to the coordination study format.
.2 Coordinate electrical work and inspection and testing company work and provide adequate advance notice as to when the work of this section will be ready for inspection and testing. Allow sufficient time to carry out inspection and testing as specified herein.
.3 Submit initial short circuit/coordination study with equipment shop drawings for Consultants review and prior to release of equipment for manufacture. If formal completion of the study may cause delay in equipment manufacturer 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.
.4 The electrical distribution system protective devices have been selected such that protection is adequate and proper coordination is possible, however, since differences do exist between manufacturers of equipment, some changes in trip ratings or relay settings may be necessary and are to be performed as part of the work, prior to energizing the electrical distribution system and these changes shall be included at no extra cost to the Owner. To determine the above, a testing and coordination study of the electrical distribution system equipment is to be performed by one of the following companies:
    .1 Siemens Westinghouse Technical Services
    .2 Schneider Canada
    .3 Cutler-Hammer Engineering Services
    .4 Or approved equivalent
.5 Short Circuit and Coordination Study: Immediately upon notification of award of Contract, arrange for

the testing company to perform the following:

.1 cooperate with and obtain from manufacturers of the distribution system equipment a list of equipment requiring protective devices to be used, and, along with the manufacturers, ensure that proper control and protective devices are selected such that they can be properly coordinated

.2 prepare, as soon as possible, a set of coordination curves on proper time current characteristic graph paper and submit to the Consultant, accompanied by supporting symmetrical as well as asymmetrical fault current calculation data with tabulations to verify protection of the various distribution system elements under maximum and minimum fault conditions at the various points in the system.

.6 The graph shall include:

.1 Up-to-date system single line diagrams for high voltage and low voltage systems

.2 Composite time-current characteristic curves of all pertinent relays, breakers, fuses and the like including the thermal damage curves for cables, transformers, motors and the like.

.3 Summation chart showing all ratings and settings referenced to the appropriate time-current characteristic curve.

.4 Three phase bolted fault current, symmetrical and asymmetrical, and minimal arching ground fault values.

.7 Plot the time current characteristic curves for the following:

.1 main and feeder protective devices at all voltage levels used in the distribution system

.2 protective devices associated with the largest motor in each motor control center, the refrigeration machine compressors (as applicable), and the largest load fed from each distribution panelboard

.3 emergency power engine generator set protective devices, damage curves, and current decrement curves

.8 Where relays, breakers, etc., do not perform to approved coordination curves they are to be revised at no cost as part of the work

.9 Complete system shall be coordinated as follows:

.1 Coordinate all protective devices in all switchgear, switchboards, distribution panels and branch circuit panels so that smaller low voltage branch feeder breaker will, in the event of fault, interrupt before main breaker. Main secondary breakers shall interrupt before high voltage breaker of fuse supplying Supply Authority transformer, and the like. Coordinate with Supply Authority.

.2 Coordinate main breakers in all panelboards so that they will trip prior to the breaker in upstream distribution equipment supplying same.

.3 Coordination shall typically include at least one stage upstream to the last protective device.

.4 Set ground fault, short time, and long time trip devices as directed by coordination study and/or Consultant.

.10 The on-site test and coordination study of distribution system protective devices is to include, as applicable:

.1 Primary and secondary voltage switchgear and transformers.

.2 Automatic load shedding and load management arrangement.

.3 Major interconnecting cables and busways.

.4 testing, cleaning when necessary, and calibrating relays and circuit breaker trip devices (calibration of protective devices is to conform to requirements of approved coordination curves)

.5 a function test of associated control devices

.6 replacement of any fuses destroyed during tests at no additional cost

.7 an acceptance test in the presence of and to the satisfaction of the Consultant

.8 the presence at the site, for the length of time required, of qualified equipment manufacturer's service representatives

.9 an insulation resistance test of "load" side feeders with respect to ground

.10 a test of cables, distribution and branch circuit panelboards, distribution transformers, power receptacles and switches

.11 testing of motor control centers, motor starters, and, where supplied as part of the electrical work, variable speed drives

.12 witnessing EMI testing and signing test reports as verification of results

.11 Necessary data required to complete this coordination study shall be obtained from the Supply Authority and manufacturers of protective devices in the system.

.12 Ensure that the suggested settings of the devices, as determined from the coordination study are acceptable to the Supply Authority.

.13 Short circuit and coordination study shall be prepared under the supervision and sealed by a Professional engineer licensed in the Province of Ontario.

.14 Inspection and testing shall be done prior to the system being energized and typically will include:

.1 Arrange with manufacturer to witness plant test of all low voltage breakers and associated control equipment and ensure proper functioning of all elements prior to shipment to site.

.2 Check all control devices in automatic transfer scheme and ascertain their proper connection prior to energizing the system.

.3 Check all bus connections, bus joints, and clearances in all equipment before energizing.

.4 Verification of potential and current transformers.

.5 All reports required from switchboard and switchgear manufacturers shall be sent to manufacturers prior to commencing of manufacturing of switchgear.

.15 Arc Flash Hazard Analysis: Perform an arc hazard analysis and prepare and submit a report with calculations to determine the flash protection boundary and the incident energy at locations in the electrical distribution system (switchboards, switchgear, motor control centers, distribution panelboards, bus duct, splitters, and other equipment where work could be performed on energized equipment. Include significant locations in systems fed from transformers 125 kVA and greater, and specify safe working distances for calculated fault locations based on the calculated arc flash boundary considering an incident energy of 1.2 cal/cm². Provide minimum 90 mm x 125 mm (3½" x 5") thermal transfer type high adhesion polyester warning labels at each work location and piece of equipment analyzed. Labels are to have an orange header with machine printed wording WARNING, ARC FLASH HAZARD, and the following information:

.1 nominal voltage

.2 flash protection boundary

.3 hazard risk category

.4 incident energy

.5 working distance

.16 Arc Flash Hazard analysis shall be prepared under the supervision and sealed by a Professional Engineer licensed in the Province of Ontario.

3.4 INTEGRATED SYSTEMS TESTING OF FIRE PROTECTION AND LIFE SAFETY SYSTEMS

.1 Participate in execution of testing and commissioning of integrated fire protection and life safety systems in accordance with CAN/ULC-S1001.

.2 Submit all required documentation to Integrated Testing Coordinator for approval prior to commencing testing on site.

.3 In general, the systems to be tested for fire protection and life safety are outlined in CAN/ULC-S1001. Where applicable the systems include but are not limited to:

.1 Fire Alarm Systems

.2 HVAC Systems (BAS Connections, Prevention of Smoke Circulation, Fire and/or smoke closures, etc.)

.3 Smoke Control Systems

.4 Emergency Lighting

.4 The process must be co-ordinated with the project construction schedule, suppliers, manufacturers, general contractor and sub-contractors with associated fire protection and life safety systems.

.5 The systems shall be tested as a whole system to verify interconnection between integrated systems. Testing must be completed once the complete fire protection and life safety system is installed. Individual component testing or partially installed assembly testing will not be accepted.

.6 Contractor shall repeat testing procedure until system has been successfully proven integrated.

.7 Submit signed testing reports to consultant upon completion.

.8 Integrated systems testing of fire protection and life safety systems testing shall be completed and associated documentation submitted to the consultant's approval prior to building occupancy.

.9 Include in O&M manuals, a periodic integrated systems testing schedule and an itemized list of

integrated fire protection and life safety systems contained within the building for owner's future reference.

.10 Include a copy of the testing plan, testing forms, re-testing forms and testing report in O&M manuals

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 26 03 00.

1.2 BASIC MATERIALS AND METHODS

.1 Conform to all sections of Division 26.

1.3 CO-ORDINATION WITH POWER SUPPLY AUTHORITY

.1 Co-ordinate and meet requirements of Supply Authority. Ensure availability of power when required.
.2 Advise Supply Authority when construction begins and when work is being done.

1.4 SUBMITTALS

.1 Shop drawings for the following:
.2 Contractor's Material and Test Certificate
.3 Fuse/breaker coordination study on log-log paper showing;
  .1 Consumer's service box fuse or breaker interrupting time-current characteristics coordinating with Supply Authority's fuse or breaker time-current characteristics so that consumer's protection will interrupt before the Supply Authority's protection interrupts.
    .1 Include transformer(s) withstand curve data.
    .2 Maximum system short circuit capacity;
    .3 Associated cabling with stand curves data.
    .4 Main service branch breakers/fuses time-current characteristics and coordination thereof with service box fuse or breaker.

2 PRODUCTS

2.1 MATERIAL

.1 Underground ducts: to Section 16105, Concrete encased Duct Banks and Manholes and as indicated.
.2 Rigid steel galvanized conduit and fittings: to Section 16111 - Raceways.
.3 Conductors: copper type RWU90, to Section 16122 - Wires and Cables, size and number of conductors as indicated.
.4 Meter socket: weatherproof to Section 16431, Metering and Switchboard Instruments to supply Authority approval.
.5 6" (150 mm) wide polyethylene underground warning tape, red colour "ELECTRICAL LINE BURIED", orange colour "TELEPHONE LINE BURIED".

3 EXECUTION

3.1 INSTALLATION

.1 Install cables in trenches and in ducts and conduit as shown on drawings.
.2 Allow adequate conductor length for connection to supply by Supply Authority.
.3 Install meter socket and conduit.
.4 Allow adequate conductor length for connection to service equipment.
.5 Make grounding connections in accordance Grounding and Bonding specifications section.
.6 See drawings for depth of hydro service and communications service cables and ducts.
.7 Provide 6" (150 mm) wide polyethylene underground warning tape, centred lengthwise, @ 12" (300 mm) below grade above all electrical and communications raceways and wiring buried exterior to building foundation walls.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Product Data: Submit product data for cable ducts.

2 PRODUCTS

2.1 PVC DUCTS AND FITTINGS

.1 Rigid type EB1 PVC duct to CSA C22.2 No.211.1, Rigid Types EB1 and DB2/ES2 PVC Conduit, with manufactured bends, coupling, bell end fittings, and similar items supplied with the duct and constructed of the same material as the duct, and solvent weld joints.

2.2 FIBREGLASS REINFORCED EPOXY DUCT

.1 Fibreglass reinforced epoxy (FRE) ducts and fittings to CSA C22.2 No. 211.3, Reinforced Thermosetting Resin Conduit RTRC and Fittings, each length complete with an expanded coupling and urethane sealing gasket.

2.3 DUCT SPACERS

.1 PVC duct spacers to maintain 75 mm (3") spacing between ducts horizontally and vertically, and to suit the configuration of the duct installation and the duct diameter.

2.4 CABLE PULLING ROPE

.1 Minimum 6.4 mm (¼") dia. stranded nylon polypropylene rope, minimum 5 kN tensile strength.

2.5 DUCT MARKER TAPE

.1 Concrete Markers: Precast concrete cable markers, minimum 600 mm x 600 mm x 100 mm thick (24" x 24" x 4") with the required wording and duct direction arrows cast into the top surface.
.2 Marker Tape: Minimum 150 mm (6") wide minimum 4 mil thick polyethylene marker tape, red with "ELECTRICAL LINE BURIED" wording for service cables, and orange with "COMMUNICATION LINE BURIED" for telephone or other buried communication cable.

3 EXECUTION

3.1 DUCT INSTALLATION REQUIREMENTS

.1 Provide all required underground ducts. Conform to drawing details and the duct manufacturer's installation instructions. Clean ducts prior to installation, and temporarily cap exposed ends of duct during construction.
.2 Locate electric service ducts a minimum of 1.2 m (48") below grade to the top of the ducts. Locate communications cable ducts a minimum of 900 mm (36") below grade to the top of the ducts. Maintain 300 mm (12") horizontal separation between electric service and communication ducts.
.3 Install the duct on undisturbed soil or on a minimum 150 mm (6") thick granular base compacted to 95% of maximum Proctor dry density, or, for unstable soil, on a 75 mm (3") thick "mud Slab". Install ducts with a slope as indicated, or if not indicated, with a minimum slope of 1 to 400 to drainage points.
.4 Provide duct spacers at minimum 1.2 m (48") centers and secure ducts to spacers. Stagger joints of adjacent ducts a minimum of 150 mm (6") and ensure that joints are water-tight.
.5 Make transpositions, offsets, and changes in direction using five degree bend sections, and do not exceed a total of twenty degrees with a duct offset.
.6 Provide bell fittings at duct terminations at manholes and buildings.
.7 Prior to concealing, request duct inspection and approval by the Consultant, and demonstrate clear

ducts by pulling a steel test mandrel, 12 mm (½") in diameter smaller than the duct diameter through each duct.

.8 Provide a continuous pull rope in each duct, with 3 m (10') of excess rope at each end.

.9 Provide continuous marker tape 300 mm (12") below grade over the ducts. Provide concrete markers set so that the top of the marker is 25 mm (1") above grade at maximum 150 m (450") intervals and at each change in direction. Locate concrete markers on "as-built" record drawings.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Product Data: Submit product data sheets for all products specified in this Section. Indicate compatibilities and limitations, and application instructions and include data to confirm that the product proposed meets all requirements of the Specification.
.2 Samples: If requested, submit identified conductor samples.
.3 MSDS Sheets: Submit Material Safety Data Sheets for conductor pulling lubricants.

2 PRODUCTS

2.1 DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

.1 Minimum gauge: #12 AWG, unless specifically noted otherwise. Conductors #12 and #10 AWG are to be solid. Conductors #8 AWG and larger are to be stranded. Use #14 AWG for control wiring unless noted otherwise. All conductors are to be constructed from 98% conductive copper and are to be approved for 600 volts. Conductors are to be colour coded, factory identified on the insulation with the manufacturer's name, conductor size and metal, voltage rating, and CSA type and designation. Conductors are to be as follows:
  .1 "T-90 Nylon" single copper conductor in accordance with CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, 90º C (194º F) rated, PVC insulated and nylon covered for #10 AWG and smaller.
  .2 "RW-90" single copper conductor in accordance with CAN/CSA C22.2 No 38, Thermoset-Insulated Wires and Cables, 90ºC (194º F) rated, X-link polyethylene insulated for #8 AWG and larger.
  .3 "AC90" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90º C (194º F) rated, X-linked polyethylene insulated copper conductors, a concentric ground conductor, and an interlocking aluminum armor jacket
  .4 "AC90 ISO-BX" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90º C (194º F) rated, X-linked polyethylene insulated copper conductors, a concentric bare ground conductor, an insulated copper ground conductor, and an interlocking aluminum armour jacket
  .5 Equal to Tyco/Raychem "RHW" cable in accordance with requirements of CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables, R90 90º C (194º F) rated, consisting of a stranded copper conductor and silicone rubber insulation, ULC 2 hour fire rated when installed in metal conduit

2.2 CONNECTORS

.1 Conductors In Conduit: Except as noted, equal to Ideal Industries Inc. "Wing Nut" CSA certified, 600 volt rated pressure type twist connectors.
.2 Conductors 3/0 AWG and Larger: Long barrel, double crimp, compression type lug connectors, unless otherwise specified.
.3 Armoured Cable: Except as noted, proper squeeze type connectors and plastic anti-short bushings at terminations in accordance with requirements of CSA C22.2 No. 18.3, Conduit, Tubing and Cable Fittings.

2.3 CONDUCTOR PULLING LUBRICANT

.1 Equal to Ideal Industries Inc. "Yellow 77" or "ClearGlide", as required.

3 EXECUTION

3.1 GENERAL RE: CONDUCTOR INSTALLATIONS

.1 Conform to the following conductor installation requirements:

.1 Conductor Routing: Conductor routing indicated on the drawings is schematic and approximate. Determine exact routing and conductor lengths at the site. Route conductors to avoid interference with other work. Unless otherwise specified or shown install conductors parallel to building lines.

.2 Conductor Pulling: When pulling conductors into conduit use lubricant and ensure that the conductors are kept straight and are not twisted.

.3 Securing/Supporting Conductors: Conform to the following requirements:

.1 Neatly secure exposed conductors in equipment enclosures with proper supports and/or ties

.2 Support flexible armoured cable in ceiling spaces and stud walls with steel two hole cable straps to Code requirements

.4 Conductor Splicing: Generally conductor splicing is not permitted unless otherwise approved by the Consultant, and if approved, splicing is subject to the following conditions:

.1 Splicing is permitted to extend existing conductors

.2 For thermoplastic insulated conductors, splices are to be made within an approved electrical box with mechanical compression connectors to suit the type and size of conductors, and the box(es) are to be properly identified and locations are to be indicated on “as-built” drawings

3.2 INSTALLATION OF DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

.1 Provide all required conductors.

.2 Non-Fire Rated Conductors: Unless otherwise specified herein or on the drawings, non-fire rated conductors are to be as follows:

.1 Conductors underground inside or outside the building, and in non-climate controlled areas – TWU

.2 Flexible armoured cable AC90 (BX) may be used ONLY for short drops to lighting fixtures (not more than 1525 mm (5 ft.) per drop.)

.3 For conductors except as specified above or elsewhere in the Specification or on the drawings - T90 Nylon or RW90

.3 Conductor Sizing: Generally, conductor sizes are indicated on the drawings. Unless otherwise specified, do not use conductors smaller than No. 12 AWG in systems over 30 volts. Unless otherwise specified, do not use conductors smaller than No. 6 AWG for exterior luminaire wiring. Conductor sizes indicated on the drawings are minimum sizes and must be increased, where required, to suit length of run and voltage drop in accordance with the voltage drop schedule found at the end of this Section.

.4 Conductor Colour Coding: Unless otherwise specified, colour code conductors to identify phases, neutral, and ground by means of self-laminating coloured vinyl tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours are to be as follows:

.1 phase A – red
.2 phase B – black
.3 phase C – blue
.4 neutral – white
.5 control – orange

.5 Communication System Colour Coding: Unless otherwise specified, colour code conductors for communication systems in accordance with the system manufacturer’s recommendations.

3.3 MAXIMUM BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 3% VOLTAGE DROP

Wire Size	Breaker Size (Amperes)	15	20	30	40	50	60	70	80	100
	Max. Load At 80% (Amperes)	12	16	24	32	40	48	56	68	80
No.12	---	22.0	16.0	---	---	---	---	---	---	---
No.10	---	36.0	27.0	18.0	---	---	---	---	---	---

No. 8	---	59.0	44.0	30.0	22.0	---	---	---	---	---

No.6	---	91.0	70.0	47.0	35.0	28.0	23.0	---	---	---
No.4	---	---	109.0	73.0	54.0	42.0	35.0	30.0	25.0	---
No.2	---	---	---	114.0	85.0	68.0	57.0	50.0	41.0	35.0
No.1	---	---	---	---	103.0	85.0	73.0	61.0	50.0	43.0
No.1/0	---	---	---	---	128.0	102.0	85.0	73.0	60.0	48.0
No.2/0	---	---	---	---	---	121.0	100.0	86.0	74.0	60.0
No.3/0	---	---	---	---	---	---	118.0	102.0	88.0	70.0
No.4/0	---	---	---	---	---	---	---	120.0	102.0	83.0
250 MCM	---	---	---	---	---	---	---	---	114.0	91.0
300 MCM	---	---	---	---	---	---	---	---	---	103.0

NOTE: DISTANCES INDICATED IN METERS FROM PANEL TO LOAD FOR SINGLE PHASE.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for metering equipment. Ensure that the drawings and sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section.

1.2 SUB-METERING ON-SITE TRAINING

.1 The digital sub-meter equipment/system manufacturer/supplier to provide a minimum two four hour on-site training sessions for the Owner's designated personnel (for up to 6 people each session) on equipment/system operation and maintenance procedures. The Operating and Maintenance Manuals are to be used during this training.

2 PRODUCTS

2.1 POWER SUPPLY AUTHORITY METER CABINET

.1 CSA certified minimum 1219 mm x 1219 mm x 300 mm deep (4' x4' x 1' deep) enameled minimum # 14 gauge sheet steel cabinet approved by the Supply Authority and complete with:
- .1 A removable minimum #12 gauge sheet steel interior mounting panel which is 80 mm (3 5/32") narrower and shorter than the width and height of the cabinet, mounted to permit a clearance of 12 mm (½") behind it
- .2 A ground connection lug on the exterior of the cabinet
- .3 Hinged double doors opening at the middle and equipped with not more than three latching points, and a non-locking latch and handle or latch-handle combination
- .4 An EEMAC 3R weather-proof enclosure rating, with door stops

2.2 SUB-METERING METERS

.1 Schneider Electric "PowerLogic" ION7300 Series Measurement Canada approved digital power and energy meters to measure and display kW, kWh, kW demand, ampere demand, kVA, kVA demand, kVAr, and kVArh. Each meter is to include:
- .1 A LCD/LED display screen
- .2 All required inputs and outputs, and contacts
- .3 RS485 port for Modbus RTU interface for communications to a remote printer, LAN, or building automation system
- .4 Current and potential transformers as required

.2 Acceptable manufacturers are:
- .1 Schneider Electric "PowerLogic"
- .2 Carma Industries Inc.
- .3 Intellimeter Canada
- .4 Eaton Corp.
- .5 Or approved alternate

3 EXECUTION

3.1 INSTALLATION OF METER SOCKETS AND ENCLOSURES

.1 Provide meter sockets with enclosures where shown. Confirm exact locations prior to roughing-in.
.2 Coordinate the installation with the Power Supply Authority who will provide the meters.

3.2 INSTALLATION OF POWER SUPPLY AUTHORITY METERING CABINET

.1 Provide a Supply Authorities metering cabinet where shown and wall mount such that the top of the cabinet does not exceed 1.8 m (6') above the finished floor level or grade, with a clear working space

of 900 mm (3') in front of the cabinet.

.2 Provide a minimum 50 mm (2") dia. empty conduit (maximum 30 m or 100') with no more than three 90º bends and nylon or polyrope pull line between the meter cabinet and the switchgear cubicle containing the metering transformers, terminated at the cubicle in accordance with the Utility's requirements.

.3 Provide a bare #2/0 copper ground conductor from the system ground to the exterior of the meter cabinet.

.4 Provide a meter socket in the cabinet and coordinate the work with the Utility who will install the meter and connect to the metering cubicle of the switchgear.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings / Product Data: Submit shop drawings and product data shop drawings and product data sheets for products specified in this Section. Ensure that the drawings and sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section. For each transformer, include:
- .1 No load losses (comply with CAN/CSA-C802-94)
- .2 Full load losses (comply with CAN/CSA-C802-94)
- .3 Polarity and phase rotation
- .4 Impedance at reference temperature
- .5 Efficiencies at 25, 75, 50 and 100% load
- .6 Regulation at 100% and 80% power factor
- .7 Audible sound level.
- .8 Insulation class and rated temperature rise
- .9 Dimensions and weight
- .10 Applied potential test
- .11 Induced potential test
- .12 Excitation current
- .13 IR, IX and IZ percentages
- .14 Reference and ambient temperature

.2 Factory Test Reports: Submit certified copies of the transformer manufacturer's standard factory testing.

.3 Installation Test Report: As specified in Part 3 of this Section, submit signed copies of the site installation test report.

.4 Transformer Extended Warranty: Submit a signed copy of the manufacturer`s extended warranty as specified below.

1.2 QUALITY ASSURANCE

.1 Dry type distribution transformers are to be in accordance with requirements of the following:
- .1 CAN/CSA-C22.2 No. 47, Air-Cooled Transformers (Dry Type)
- .2 CSA-C9, Dry-Type transformers
- .3 CAN/CSA-C802.2, Minimum Efficiency Values for Dry-Type Transformers
- .4 NEMA TP1, Guide for Determining Energy Efficiency for Distribution Transformers
- .5 ANSI/IEEE C57.110, Recommended Practice for Establishing Transformer Capability When Supplying Non-sinusoidal Load Currents

1.3 EXTENDED WARRANTY

.1 Dry type transformers are to be covered by a 10 year non-prorated extended warranty direct from the manufacturer to the Owner against defects in material, workmanship, and performance.

2 PRODUCTS

2.1 DRY TYPE TRANSFORMERS

.1 Dry type enclosed and ventilated transformers, factory assembled and tested, supplied with a 10 year extended warranty as per Part 1 of this Section with sound levels in accordance with CSA-C9 requirements and the following features:

.2 a minimum NEMA/EEMAC 3R enclosure with rigid end frame, removable gasketed front and rear plates, a bottom terminal compartment, ventilation louvers designed to protect internal live parts from fire protection sprinkler system spray, a drip shield, a factory ASA No. 61 light grey enamel finish, an aluminum nameplate secured by rivets to the front of the enclosure and listing impedance rating, weight, connection diagram, style and serial number, and, where required by governing Codes and

Regulations, seismic restraint facilities for site connection

.3 600 volt primary,120/208 volt secondary, kVA as indicated, 60 Hz.

.4 Copper windings, a core constructed of stacked laminations of high permeability silicone steel, epoxy resin impregnation, and Class F silicone type coil insulation such that the winding temperature rise will not exceed 115° C (240° F) under full load in a 40°C (104° F) ambient temperature

.5 An electrostatic shield for the attenuation of voltage spikes, line noise, and transients

.6 Lugs or pressure type terminals to suit primary and secondary conductors

.7 Four 2½% full capacity taps, 2 above normal and 2 below normal; taps shall be provided on primary side of transformer

.8 Integral vibration dampening with anti-vibration pads between the core and enclosure

.9 T-connected transformers are not acceptable

.10 Acceptable Manufacturers: Acceptable manufacturers are:

- .1 Schneider Electric (Square D)
- .2 Rex Power Magnetics Div. of Transformer Industries Inc.
- .3 Siemens Electric Ltd.
- .4 Hammond Power Solutions Inc.
- .5 Bemag Transformer Inc. (Pioneer Power Solutions Inc.)
- .6 Or approved alternate

3 EXECUTION

3.1 INSTALLATION OF DRY TYPE TRANSFORMERS

.1 Provide dry type transformers where shown. Ensure that adequate operation and maintenance clearance is maintained on all sides of each transformer as per Code requirements.

.2 Secure each transformer 75 KVA and larger, level and plumb, on suitable rubber-steel-rubber vibration isolation pads on a concrete housekeeping pad.

.3 Provide seismic restraints in accordance with Code requirements.

.4 Ground and bond transformers to the requirements of the Section entitled Grounding and Bonding and to O.E.S.C.

.5 Isolate primary and secondary connections from transformer enclosures by means of from 300 mm to 450 mm (12” to 18”) of liquid-tight flexible conduit.

.6 Identify each transformer with and engraved Lamacoid nameplate in accordance with requirements of the Section entitled Basic Electrical Materials and Methods. Confirm nameplate wording with the Consultant prior to manufacture.

3.2 VERIFICATION AND TESTING

.1 Test and verify transformer secondary voltage and make any required adjustments to produce secondary voltages specified. Re-test and verify voltages when the building is in normal operation. Submit signed testing and verification reports as per Part 1 of this Section.

3.3 TRAINING AND INSTRUCTIONS

.1 Include for a minimum of two separate four hour system operation and maintenance training sessions for up to six persons per session, to be held at the site.

.2 Prepare and submit for review, an outline of the proposed training session, including a list of all documents visual aids, etc., to be used.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings/ Product Data: Submit shop drawings and product data sheets for products specified in this Section. Ensure that the shop drawings and data sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section.

.2 Panelboard Door Keys: Submit an identified key (minimum 3) for panelboards equipped with doors. Key panelboards alike.

1.2 QUALITY ASSURANCE

.1 Distribution panelboards are to be rated to interrupt and withstand short circuit faults greater than the available fault current. Indicate conformance with this requirement on product data sheets submitted for review.

2 PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

.1 General Re: Panelboards: Distribution panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit devices, as per the drawing schedule and plans, and in accordance with requirements of CAN/CSA-C22.2 No. 29, Panelboards and Enclosed Panelboards Industrial Products. Comply with OESC Rule 14-014 with regards to series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices are installed are marked with a series combination interrupting rating at least equal to the available fault current. Each panelboard is to be complete with:

- .1 Silver plated, electrical grade, 95% conductivity copper bus mains for the full length of each enclosure
- .2 Main and branch circuit conductor solderless lugs approved for copper conductors
- .3 Neutral bus and main lugs at the same end, and a removable cover for main lugs
- .4 Panelboards to be complete with dedicated ground bus as well as neutral and phase buses.

.2 Panelboard Enclosures: Panelboard enclosures, unless otherwise specified, are to be EEMAC 2 sprinkler-proof, constructed of Code gauge galvanized sheet steel, equipped with drip shields, and factory cleaned, primed, and finished with ASA-61 light gray equipment enamel. Each enclosure is also to be equipped with:

- .1 Wiring gutter space on all sides in accordance with CAN/CSA-C22.2 No. 29 requirements
- .2 Space for future breakers/switches as applicable and as per the drawing schedule, and where spare breaker space is scheduled, breaker connector kits
- .3 For panelboards in areas other than secure Electrical, etc., Rooms, a concealed hinged door and flush latch with keyed alike lock
- .4 Panelboard interiors to be painted white.

.3 Circuit Breaker Panelboards: Breakers are to be moulded case, bolt-on breakers in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, calibrated for operation in a 40º C (105º F) ambient temperature, sized in accordance with the drawing schedules, and complete with:

- .1 A top main breaker, as indicated.
- .2 For breakers 200 amperes and larger, a solid-state adjustable trip unit with long time, short time, and instantaneous (LSI) time functions and time delays or long time, short time, instantaneous and ground-fault (LSIG) and time delays where indicated, set at ratings in accordance with the distribution coordination study

.4 Circuit Breakers: Breakers are to be moulded case, bolt-on breakers in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and circuit Breaker Enclosures, calibrated for operation in a 40ºC (105ºF) ambient temperature, sized in accordance with the drawing schedules, and as follows:

- .1 Thermal magnetic type circuit breaker, quick-make, quick-break for manual and automatic operation for general purpose

.2 Current limiting time-limit type quick-make, quick-break for manual and automatic operation for motor protection
.3 Branch circuit breaker interrupting capacity is to suit the panelbaord voltage and be as scheduled and in accordance with OESC requirements to suit the application.
.4 For ground fault breakers, CSA Class A, Group 1 combination thermal magnetic trip breakers with solid-state ground fault interrupters
.5 for breakers 200 amperes and larger, a solid-state adjustable trip unit with long time, short time, and instantaneous (LSI) time functions and time delays, or long time, short time, instantaneous and ground-fault (LSIG) and time delays where indicated, set at ratings in accordance with the distribution coordination study
.6 For dedicated breakers, handle lock devices
.7 As scheduled or shown, spare breakers and space for future breakers

.5 Acceptable Manufacturers: Acceptable manufacturers are:
.1 Schneider Electric (Square D)
.2 Siemens Electric Ltd.
.3 Eaton Corp. (Cutler-Hammer)

3 EXECUTION

3.1 INSTALLATION OF DISTRIBUTION PANELBOARDS

.1 Provide distribution panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.
.2 Wall mount panelboards independent of connected conduit.
.3 Identify each panelboard and each panelboard component with and engraved Lamacoid nameplate in accordance with requirements of the Section entitled Basic Electrical Materials and Methods. Confirm nameplate wording with the Consultant prior to manufacture. Include a printed circuit directory card in a frame with acetate cover.
.4 From each recessed panel, except residential suite panels, and unless otherwise noted, provide minimum 2 @ 1" (25 mm) empty conduits up to accessible ceiling space directly above panel. Terminate each in a 4" (100 mm) square box with BM cover.
.5 Provide 25% spare breakers in each panel based on number of circuits in use.
.6 Provide 25% breaker spaces in each panel based on number of circuits in use.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for products specified in this Section.
.2 Test Reports: Submit signed test reports for all testing work specified.

2 PRODUCTS

2.1 GROUND RODS

.1 Copper-Clad rods, 20mm (3/4′′) dia, 3m (10′) long, complete with a driving cap and a bronze tip.

2.2 GROUNDING AND BONDING CONDUCTORS

.1 Equipment Grounding Conductors: Unless otherwise specified, insulated (green colour) stranded copper conductors, except that conductors #10 gauge and smaller may be solid copper.
.2 Bonding Conductors: As for equipment ground conductors but bare copper.

2.3 GROUNDING AND BONDING CONNECTIONS

.1 Below Grade: Equal to Erico International Corp. “Cadweld” exothermic welded connections.
.2 Above Grade: Compression type connectors with zinc-plated fasteners and external tooth lock washers, or, if approved by the Consultant, exothermic connections as for below grade connections

3 EXECUTION

3.1 GENERAL ELECTRICAL WORK GROUNDING REQUIREMENTS

.1 Perform all required electrical work grounding and bonding. Unless otherwise specified, grounding and bonding work is to be in accordance with requirements of CAN/CSA-C22.2 No. 0.4-04. Bonding of Electrical Equipment, and the requirements of all other governing authorities.
.2 Bond metallic conduits, boxes, cable trays, ducts, and non-current carrying metal parts of equipment together to form a continuous ground system. In electrical equipment rooms, solidly bond circuits, switchgear, switchboards, panelboards, transformers, conduits, equipment enclosures, and other equipment to perimeter ground bus using bronze connectors and hardware.
.3 Install connectors in accordance with the manufacturer’s instructions.
.4 Protect exposed grounding conductors from mechanical injury. Install underground conductors a minimum of 450 mm (18”) below grade.
.5 Use tinned copper conductors for aluminum structures.
.6 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.2 EQUIPMENT GROUNDING

.1 Provide grounding connections to mechanical and electrical equipment as shown and/or specified on the drawings and in accordance with CAN/CSA C22.2 No. 0.4 and requirements of governing authorities.
.2 Ground hinged doors of electrical equipment to the equipment enclosure main frame using flexible jumpers.

3.3 FIELD QUALITY CONTROL

.1 Prior to energizing the electrical distribution system perform ground continuity and resistance tests using the 62% or “fall of potential” to confirm proper resistance to ground values and submit signed

test results.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Submit the following for review:
.2 Product data sheets: submit for special conduit as the Consultant directs
.3 Additional submittals: submit any other submittals specified in this Section of the Specification

2 PRODUCTS

2.1 EMT

.1 Galvanized electrical metallic tubing (EMT) to CSA C22.2 No. 83, complete with an interior coating, factory made bends where site bending is not possible, and joints and terminations made with steel couplers and set-screw type connectors with insulated throats, concrete tight where required.

2.2 RIGID GALVANIZED STEEL CONDUIT

.1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an interior enamel coating, galvanized threads where factory cut, red lead coated threads where site cut, factory made bends where site bending is not possible, factory made and threaded fittings and connectors, and terminations made with rigid couplings, concrete tight where required.

2.3 FLEXIBLE GALVANIZED STEEL LIQUID-TIGHT CONDUIT

.1 Flexible galvanized steel liquid-tight conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal, complete with conduit connectors to suit the application.

2.4 RIGID ALUMINUM CONDUIT

.1 Factory or site threaded rigid aluminum to CSA C22.2 No. 45, Rigid Metal Conduit, with bending, coupling, fitting, etc., requirements as specified for rigid galvanized steel conduit.

2.5 FLEXIBLE NON-METALLIC (PVC) CONDUIT

.1 Equal to Ipex Electrical Inc, “Cor-line” flexible, water-tight, corrugated PVC conduit (ENT) with “Kwikon” fittings to CSA C22.2 No. 221.3, Flexible Non-metallic Conduit, complete with ESU supports and proper and suitable terminations and adapters.

2.6 COLOUR COATED EMT

.1 Equal to Allied Tube and Conduit “True Color” EMT, as specified for standard EMT but factory coated with colours as selected by the Consultant.

2.7 FRE CONDUIT

.1 Reinforced thermosetting resin conduit (RTRC) and fittings to CSA C22.2 no. 2420-09, below ground reinforced thermosetting resin conduit (RTRC) and fittings.

2.8 FISH CORD

.1 Polypropylene rope.

3 EXECUTION

3.1 CONDUIT INSTALLATION REQUIREMENTS

.1 General: Refer to the article entitled General Conduit and Conductor Installation Requirements in Part

3 of the Section entitled Basic Electrical Materials and Methods.

.2 Conduit Types: Unless otherwise specified, provide conduit for all conductors except armoured cable, and except where cable duct or tray or similar product is used. Conduit is to be as follows:
- .1 For main distribution wiring in electrical rooms and similar areas – rigid galvanized steel
- .2 For exposed conduit from floor level to 1.2 m (4') above the floor in mechanical and other service rooms – rigid galvanized steel
- .3 For concealed conduit in exterior walls – rigid galvanized steel
- .4 For explosion-proof wiring – rigid galvanized steel
- .5 For conduit exposed outside the building rigid aluminum conduit
- .6 For short (minimum 450 mm (18"), maximum 600 mm (24") with a 180º loop wherever possible) runs of conduit to motors, distribution transformers, and vibration isolated equipment – flexible galvanized steel liquid-tight conduit
- .7 For branch circuit conductors underground inside the building, and underground outside the building beneath structures and concrete or asphalt paving – rigid PVC
- .8 For branch circuit conductors outside the building at roof level – rigid aluminum
- .9 For all conduit except as specified above – EMT
- .10 For fire alarm and other communication system conductors – colour coated EMT with colours as selected

.3 Conduit Fittings: Unless otherwise specified, conduit fittings are to be constructed of the same material as the conduit and are to be suitable in all respects for the application. Provide proper adaptors for joining conduits of different materials.

.4 Conduit Sizes: Generally, conduit is sized on the drawings. Conduit not sized on the drawings is to be sized in accordance with the Ontario Electrical Safety Code. The sizes of branch circuit conductors specified are minimum sizes and must be increased to suit length of run and voltage drop as specified, therefore, when conductor sizes are increased to suit length of run and voltage drop, increase the conduit size to suit. Sizes indicated do not include allowance regarding percentage conduit fill for bonding and grounding conductors unless noted otherwise. Increase conduit size as necessary to comply with OESC-12-1014(4). Conductors in conduit. Do not install conduit less than 19 mm (3/4") dia.

.5 Conduit Bends: Site made bends for all conduit must be made using proper bending equipment, bends must maintain the full conduit diameter with no kinking, and conduit finishes must not flake or crack when the conduit is bent.

.6 Site Cutting Conduit: Cut square and ream all site made conduit ends. Plug or seal ends of roughed-in conduit which are open and exposed during construction.

.7 Threading Conduit: Site cut threaded rigid conduit using proper threading equipment located in an approved area and where protection for adjacent building surfaces is in place. Clean threads and lubricate. Coat rigid conduit threads with red lead or other zinc rich coating. Field threads must be of sufficient length to draw conduits up tight.

.8 Empty Conduit: Ensure that all conduit left empty for future wiring is clean, capped, and suitably identified. Provide end bushings and fish cord in all such conduit.

.9 Empty Conduit at Panelboards: Provide four, empty, 25 mm (1") dia. conduits terminated in the ceiling space from each flush wall mounted branch circuit panelboard located under or adjacent to a suspended ceiling.

.10 Conduit in Concrete
- .1 Do not install conduits in cast-in-place concrete slab on grade or suspended slab.

.11 Conduit in Concrete: Conform to the following requirements:
- .1 Where conduit or sleeves pass through cast-in-place structural concrete or where conduit is to be embedded in structural concrete, install the conduit in compliance with requirements of CAN/CSA A23.1, Concrete Materials and Methods of Concrete Construction, with specific reference to Section 13.5
- .2 All conduit in cast-in-place concrete must be secured in a manner such that the conduit will not float when the concrete is poured, and during the concrete pour, the work must be observed to ensure that the conduit is not damaged and is protected from water and/or concrete penetration
- .3 Where conduits pass by a column, stay at least two times the thickness of the slab and drop away from the column
- .4 Where conduits terminate adjacent to a column or wall, bring the conduit in toward the

column/wall as close to 90º to the face of the column as possible within two times the thickness of the slab and drop away from the column

.5 The maximum size of conduit in structural slabs is 1/5 of the solid portion of the slab thickness

.6 Where more than two conduits are adjacent to each other, they are to be spaced the greater of 3 diameters or 100 mm (4") apart

.7 The total depth of conduits crossing over each other is to be less than one-third the thickness of the slab

.8 Place conduit in the middle third of the thickness of the slab, and in no case allow conduit to lay directly on the reinforcing steel

.9 Do not run conduit adjacent to parallel reinforcing bars

.10 Do not run conduit longitudinally in a beam without specific approval of the Consultant, and pass through beams at right angles to the span of the beam

.11 Where conduits pass through beams, stay at least twice the depth of the beam away from the supports

.12 Do not run conduits in the slab beside a drop or beam within twice the depth of the slab from the edge of the drop or beam

.13 Do not run conduits through shear walls or columns without the specific approval of the Consultant

.14 Do not place conduit in structural elements in parking garage structures, water retaining structures, or any other structures subjected to de-icing chemicals, without the specific approval of the Consultant

.15 In areas where conduit is not approved by Consultant to be embedded in the concrete, run conduits through beams via sleeved openings coordinated with the trades involved and approved by the Consultant

.12 Support of Conduit: Conduit support requirements are as follows:

.1 Support underground conduit on a well tamped bed of earth or sand, free from rocks or other protrusions of any kind

.2 Support and secure surface mounted and suspended single or double runs of metal conduit at support spacing in accordance with the Ontario Electrical Safety Code by means of galvanized steel pipe straps, conduit clips, ring bolt type hangers with galvanized steel hanger rod, or by other approved manufactured devices

.3 Support multiple metal conduits by means of conduit racks and galvanized steel rod with spacing to suit the requirements of the smallest dia. conduit in the group

.4 Perforated pipe straps not acceptable

.13 Conduit Under Slabs-On-Grade: Any proposed use of conduit runs underground below slab, must include for following provisions:

.1 Concrete encase conduits of non-ferrous materials and slope to drain properly into a "soak-away" pit

.2 The system is to be a pull-in system

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings and Product Data: Submit shop drawings and product data sheets for disconnect switches and accessories. Ensure that the shop drawings and product data sheets indicate all features of the disconnects to confirm that the equipment is in accordance with the requirements of this Section.

2 PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Heavy-duty, CSA certified, quick-make/quick break action switches complete with a handle suitable for padlocking in the “off” position and arranged so that the door cannot be opened with the handle in the “on” position and an EEMAC enclosure. Fusible units are to be complete with fuse clips to suit fuse types specified below, without adaptors.

.2 Fuses: Unless otherwise scheduled or specified fuses are to be equal to English Electric Ltd. HRC fuses, Form I Class “J” for constant running equipment and Form II Class “C” for equipment that cycles on and off. Equivalent fuses by Mersen or Cooper-Bussman are acceptable.

.3 Enclosures: Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:

- .1 All enclosures located in sprinklered areas – Type 2
- .2 All enclosures exposed to the elements – Type 3R, constructed of stainless steel
- .3 All enclosures inside the building in wet areas – Type 3R, constructed of stainless steel
- .4 All enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application
- .5 All enclosures except as noted above – Type 1
- .6 All enclosures located in finished areas – as above but recessed type with brushed stainless steel faceplate

.4 Acceptable Manufacturers: Acceptable manufacturers are:

- .1 Rockwell Automation (Allen-Bradley)
- .2 Eaton Corp. (Cutler-Hammer)
- .3 Siemens Canada
- .4 Schneider Electric Ltd. (Square D)

3 EXECUTION

3.1 INSTALLATION OF DISCONNECT SWITCHES

.1 Provide all required disconnect switches in accordance with drawing plans, schedules, details, and requirements of the Specification.

.2 Provide fuses for fusible disconnects.

.3 Refer to the Section titled, Wiring Requirements For Mechanical Equipment.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings and Product Data: Submit shop drawings and product data sheets for splitter trough and accessories.

2 PRODUCTS

2.1 SPLITTER TROUGH

.1 Formed #16 gauge steel Type 1 splitter trough in accordance with CSA C22.2 No.76, Splitters, finished inside and outside with ANSI 61 gray heat cured powder epoxy paint, and complete with welded seams ground smooth, various size knockouts on each side, back mounting holes, removable doors with stainless steel hinges and hinge pins, terminal blocks for conductor connections, a single point ground lug

.2 Enclosures: Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:

.1 All enclosures located in sprinklered areas – Type 2

.2 All enclosures except as noted above – Type 1

3 EXECUTION

3.1 INSTALLATION OF SPLITTER TROUGH

.1 Provide all required splitter trough in accordance with drawing plans, schedules, details, and requirements of the Specification.

.2 Rigidly secure in place.

.3 Refer to the Section entitled Wiring Requirements For Mechanical Equipment

END OF SECTION

1 GENERAL

1.1 PRODUCT DATA COORDINATION

.1 Shop Drawings and Product Data: If required, review shop drawings and product data sheets for mechanical equipment requiring wiring connections as part of the electrical work to ensure that all connection requirements are performed.

2 PRODUCTS

2.1 WIRING PRODUCTS

.1 Wiring products such as conduit, conductors, boxes, etc., are to be as specified in appropriate Sections of this Division of the Specification.

3 EXECUTION

3.1 WIRING CONNECTIONS FOR MECHANICAL WORK

.1 Unless otherwise specified or indicated, perform the following electrical wiring work:

- .1 "Line" side power wiring to motor starters or disconnect switches in motor control centres and "load" side wiring from the starters or disconnects to the equipment
- .2 "Line" side power wiring to motor starters or disconnect switches on motor starter panels and "load" side wiring from the starters or disconnects to the equipment
- .3 "Line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment
- .4 "Line" side power wiring to pre-wired power and control panels and "load" side power wiring from the panels to the motors
- .5 "Line" side power wiring to variable frequency drives and "load" side power wiring from the VFD's to the motors
- .6 Provision of receptacles for plug-in equipment
- .7 Provision of disconnect switches for all motors that are in excess of 10 m (30') from the power supply/starter location, or that cannot be seen from the power supply/starter location, and all associated power wiring
- .8 All motor starter interlocking in excess of 24 volts
- .9 Wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts
- .10 Provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work
- .11 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers
- .12 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units
- .13 120 volt wiring connections to duplex receptacles integral with air handling unit control panels
- .14 120 and 208 volt wiring connections to electric space heating units integral with air handling units.

.2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work will be done as part of the mechanical work.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings and Product Data: Submit shop drawings and product data sheets for all cable tray and accessories. Include data to confirm that the cable tray proposed meets all requirements of the Specification.

.2 Layout Coordination Drawings: Contract drawings are diagrammatic. Submit floor plans and elevations drawn to scale with site measurements to indicate the proposed cable tray layout and relationships between components and adjacent structural, architectural, and mechanical elements.

.3 Samples: Submit a sample of each type of cable tray to be supplied.

1.2 QUALITY ASSURANCE

.1 All cable tray systems are to be CSA certified in accordance with CAN/CSA C22.2 No. 126.1, Metal Cable Tray Systems.

2 PRODUCTS

2.1 BASKET TYPE CABLE TRAY

.1 Wire basket type cable tray with size(s) as indicated on the drawings, constructed in straight sections from high-strength steel wires formed into a standard 50 mm x 100 mm (2” x 12”) wire mesh with intersecting wires welded together, with at least one bottom longitudinal wire along the entire length of each section. The tray is to be supplied with connector assemblies, clamp assemblies, connector plates, splice plates and bars which are CSA approved as a ground conductor, rounded edges and smooth surfaces, and complete with additional features as follows:

- .1 Constructed from 5 mm (0.195”) diameter hot dipped galvanized steel wire with a continuous top wire safety edge that is kinked and T-welded
- .2 Fittings field formed from straight sections of tray in accordance with the manufacturer’s instructions
- .3 Trapeze hangers or wall brackets as required

.2 Acceptable manufacturers are:

- .1 Canadian Electrical Raceways Inc.
- .2 Cooper B-Line
- .3 Legrand-Cablofil
- .4 Thomas & Betts
- .5 Or approved alternate

3 EXECUTION

3.1 INSTALLATION OF CABLE TRAY

.1 Provide cable tray where shown, complete with horizontal and vertical bends, tees, drop-outs, and all required accessories.

.2 Support suspended tray level and plumb, by means of trapeze hangers and 9.5 mm (3/8”) diameter galvanized steel hanger rods. Support wall mounted tray by means of wall brackets supplied with the tray. Locate all supports at 1.5 m (5’) centres and within 300 mm (1’) of each change in direction.

.3 Provide continuous paths along the entire lengths of the cable tray to maintain proper ground continuity. Utilize the system manufacturer’s proper grounding fittings and hardware.

.4 Test cable tray to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.

.5 Install expansion connectors where cable tray crosses building expansion joints.

.6 Ensure that sufficient space is provided around cable tray to permit access for installing and maintaining cables.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings and Product Data: If requested, submit shop drawing and product data sheets for products specified in this Section. Include data to confirm that the product proposed meets all requirements of the Specification.

.2 Samples: If requested, submit samples of products specified in this Section.

2 PRODUCTS

2.1 OUTLET BOXES

.1 Each box is to be CSA certified, suitable in all respects for the application, and be complete with suitable securing lugs, connectors suitable for the connected conduit, knockouts, and, where necessary, suitable plaster rings, concrete rings, covers and any other required accessory. Unless otherwise specified, outlet boxes are to be as follows:

.1 Stamped, electro-galvanized steel outlet boxes

.2 Equal to Hubbell Canada Inc. UL Scrub-Water exclusions or compliant, fully adjustable both vertical and angular, formed galvanized cast iron, round, rectangular, or square as required flush concrete floor boxes complete with adjustable collars and brass screw-on or hinged flip-open covers with provisions for installation of duplex power receptacles, telephone data jacks, and boxes containing both power and communication system outlets are to be barriered

.3 Hubbell or Legrand-Wiremold flush, fire rated “poke-through” box assemblies to suit the devices required with gray, black or brass flanges as indicated and covers as selected by the Consultant

2.2 PULL BOXES AND JUNCTION BOXES

.1 Each box is to be CSA certified, sized to suit the number and size of conduit and conductors, and complete with connecting and securing facilities. Unless otherwise specified, pull boxes and junction boxes are to be as follows:

.1 Galvanized or prime coat plated steel, suitable in all respects for the application and complete with screw-on or hinged covers as required and connectors suitable for the connected conduit

.2 “Condulet”, threaded galvanized cast iron or cast aluminum pull boxes and junction boxes of an exact type to suit the application, each complete with screw-on gasketed cover

3 EXECUTION

3.1 INSTALLATION OF OUTLET BOXES AND BACK BOXES

.1 Provide an outlet box or back box for each luminaire, wiring device, telephone outlet, fire alarm system component, communications systems components, and all other such outlets.

.2 Stamped Galvanized Steel: Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where the connecting conduit is EMT, are to be stamped galvanized steel outlet boxes unless otherwise noted.

.3 “FS and “FD” Series Boxes: Outlet boxes for surface mounted exterior lighting, receptacles, and other device outlets, boxes flush mounted in exterior building surfaces, and boxes mounted in interior device locations where the connecting conduit is rigid, and for boxes in perimeter walls where insulation and vapour barrier is present, are to be “FS” or ”FD” Series cast boxes unless otherwise noted, cast iron inside the building, cast aluminum outside the building.

.4 Flush Floor Boxes: Provide water-tight flush floor boxes where shown, install in accordance with the manufacturer’s instructions, and ensure that the boxes are not dislodged during the concrete pour.

.5 Flush Floor Boxes In Existing Concrete Slabs: Flush “poke-through” box assemblies installed in 150 mm (6”) diameter core drilled openings and connected with conduit at the underside of the slab.

.6 Outlet boxes for special wiring devices, for special equipment and special applications if required, are specified hereinafter in other Sections or on the drawings.

.7 The size and arrangement of outlet boxes are to suit the device which they serve.

.8 Generally, mounting heights and locations for outlets are indicated on the drawings, however, confirm the exact location and arrangement of all outlets prior to roughing-in. Architectural drawings and the Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting height and locations. In addition, abide by the following requirements:

- .1 Locate flush mounting boxes in masonry wall to require cutting of the masonry unit corner only and, coordinate masonry cutting to achieve a neat opening
- .2 Position outlet boxes to locate luminaires as shown on reflected ceiling plans
- .3 Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes

.9 Do not install outlet or back boxes "back-to-back" in walls and partitions. Stagger such outlets and seal against noise transmission with acoustic insulation. "Thru-wall" type boxes will not be permitted for any application.

.10 Where boxes are multi-ganged or grouped together, mount boxes level and spaced consistently.

.11 Temporarily pack all open boxes located in concrete and masonry to prevent debris from entering the box. Remove packing on completion of work.

.12 Include all costs for installed boxes that have not been covered by wall/ceiling finishes, to be relocated up to 1m (3') to suit final device location coordination.

.13 Provide blank coverplates over all boxes left empty for future installation of devices. Clearly identify each box as to its intended use to the Consultant's approval. Generally, blank coverplates are to be stainless steel.

3.2 INSTALLATION OF PULL BOXES AND JUNCTION BOXES

.1 Provide pull boxes in conduit systems wherever shown on the drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100') in length, or with more than three 90º bends, are to be equipped with a pull box installed at a convenient and suitable intermediate accessible location.

.2 Provide junction boxes wherever required and/or indicated on the drawings.

.3 Unless otherwise specified, boxes are to be as follows:

- .1 In rigid conduit and EMT inside the building – stamped galvanized or prime coated steel
- .2 In exterior rigid conduit – "Condulet" cast aluminum gasketted boxes unless otherwise noted
- .3 In plastic conduit – rigid PVC boxes
- .4 In bronze underwater conduit – cast bronze boxes

.4 All pull boxes and junction boxes must be accessible after the work in complete.

.5 Accurately locate and identify all concealed pull boxes and junction boxes on "built" record drawings.

.6 Cover boxes in fire walls with aluminum tape and seal with caulking.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings and Product Data: Submit shop drawings and product data sheets for wiring devices. Ensure that the sheets indicate all features of the devices to confirm that the devices are in accordance with requirements of this Section, including colours and faceplate finishes.

1.2 QUALITY ASSURANCE

.1 All wiring devices are to be CSA certified as a minimum, in accordance with the following standards, as applicable:
  .1 CAN/CSA C22.2 No 42, General Use Receptacles, Attachment Plugs and Similar Wiring Devices
  .2 CAN/CSA C22.2 No 42.1, Cover Plates for Flush Mounted Devices
  .3 CSA C22.2 No. 111, General Use Snap Switches

.2 Wherever possible, all wiring devices are to be supplied by the same manufacturer.

.3 Acceptable Manufacturers: Unless otherwise specified in this Section or on the drawings, acceptable manufacturers are:
  .1 Hubbell Canada
  .2 Cooper Industries (Arrow Hart)
  .3 Legrand/Pass & Seymour
  .4 Leviton Canada
  .5 Or approved alternate

1.3 WIRING DEVICE AND PLATE COLOURS

.1 Unless otherwise specified, wiring device colours will be as specified in Part 3 of this Section.

2 PRODUCTS

2.1 SWITCHES

.1 Unless otherwise specified, Specification Grade, Premium Quality, back and side wired, 20 ampere, 120-277 volt A.C. quiet action toggle switches, single pole, 2-pole, 3-way, 4-way or key type as indicated on the drawings, each complete with a nickel plated steel ground terminal, brass power wiring terminals and screws, silver cadmium oxide contacts with a moveable brass contact arm, and nylon toggle with colour as specified below. Switch types are as follows:
  .1 Standard Wall Toggle Switches: As above.
  .2 Illuminated Handle Standard Wall Toggle Switch: As above for standard switches but with a clear red, or green polycarbonate toggle which is illuminated when the switch is on or off. Confirm toggle colour and position when illuminated prior to ordering.
  .3 Decorative Wall Rocker Switch: Generally as specified above for standard toggle switches but rectangular decorative rocker type with rocker handles.
  .4 Illuminated Decorative Wall Rocker Switch: Generally as specified above for decorative toggle switches but with a rocker type illuminated handle.
  .5 Door Switch: Box, switch and plate assemblies with a 125 volt 3 ampere illuminated switch which is on or off when the door is open (confirm prior to ordering), a 34 mm x 94 mm x 40 mm (1 11/32” x 3 11/16” x 1½”) box, cover plate, and mounting screws.

2.2 SPECIFICATION GRADE STANDARD RECEPTACLES

.1 Back or side wired, U-ground, 2-pole receptacles as follows:
  .1 15 Amp. 125 Volt Duplex Receptacle: 3-wire receptacles, NEMA configuration 5-15R
  .2 15 Amp. 250 Volt Duplex Receptacle: 3-wire receptacles, NEMA configuration 6-15R
  .3 20 Amp. 125 Volt Duplex Receptacle: 3-wire receptacles, NEMA configuration 5-20R
  .4 20 Amp. 250 Volt Duplex Receptacle: 3-wire receptacles, NEMA configuration 6-20R

.5 30 Amp. 250 Volt Simplex Receptacle: 3-wire receptacles, NEMA configuration 6-30

2.3 SPECIFICATION GRADE LOCKING RECEPTACLES

.1 Specification Grade, back or side wired, U-ground, 2-pole, 3-wire locking type receptacles as follows:
- .1 15 Amp. 125 Volt Duplex Receptacle: NEMA configuration L5-15R
- .2 15 Amp. 250 Volt Duplex Receptacle: NEMA configuration L6-15R
- .3 20 Amp. 125 Volt Duplex Receptacle: NEMA configuration L5-20R
- .4 20 Amp. 250 Volt Duplex Receptacle: NEMA configuration L6-20R.

2.4 SPECIFICATION GRADE GROUND FAULT RECEPTACLES

.1 Heavy-duty, 15/20 ampere, 125 volt, ULC Class “A”, Group 1. automatic ground fault circuit interrupting duplex receptacles with a 10 kA short circuit current rating, automatic self-test diagnostics, green power on LED, and red ground fault LED. Ground fault receptacles for indoor climate controlled and outdoor or non-climate controlled areas are to be as follows:
- .1 Indoor climate controlled areas: equal to Hubbell Canada No. GFST20 “AUTOGUARD”
- .2 Outdoor areas and indoor non-climate controlled area: equal to Hubbell Canada No. GFR 5362 “AUTOGUARD”

2.5 PHOTOELECTRIC SWITCH

.1 Equal to Tork 2100 Series weather-proof, 12 mm (½”) dia. conduit mounting photoelectric SPST control switch with model number to suit the voltage and connected load, complete with an adjustable slide for on-off adjustment, a turn-on of one to five fc and a turn-off of three to five fc without the slide in position, a die-cast zinc gasketed enclosure, cadmium sulphide epoxy coated cell, normally closed contacts which fail in the open position, a delay of up to four minutes to prevent false switching due to light from vehicles, lightning, etc., three colour coded 150 mm (6”) #16 AWG leads, a fixed base for conduit connection, and, if required, an accessory bracket for wall mounting the device.

2.6 DEVICE FACEPLATES

.1 Device faceplates are to be ULC listed and CSA certified and, unless otherwise specified, supplied by the device manufacturer. Where two or more devices are installed in a common box, a common one-piece faceplate is to be used. Faceplate colours are specified in Part 3. Faceplates, unless otherwise specified, are to be as follows:
EDIT NOTE: Reference paragraph .1. Use for flush wall mounted devices in residential construction suites and “economy” projects.
- .1 Phenolic switch and receptacle faceplates, complete with color matching screws
- .2 “Decorator” type Phenolic switch and receptacle faceplates
- .3 Type 302/304 stainless steel switch and receptacle faceplates, satin finish as directed, with stainless steel screws
- .4 High impact smooth finish nylon switch and receptacle faceplates
- .5 Hot dipped galvanized steel switch and receptacle faceplates
- .6 NEMA 3 rated, single gang, horizontal/vertical mounting, weather-proof in use, gasketed cast aluminum receptacle faceplates to suit the type of receptacle used
- .7 Weather-proof, gasketed, water-tight single gang type 302 stainless steel switch plate with clear silicone rubber bubble over the switch toggle

3 EXECUTION

3.1 GENERAL RE: INSTALLATION OF WIRING DEVICES

.1 Provide all required wiring devices and faceplates.
.2 Confirm exact locations, including mounting heights, prior to roughing-in.
.3 For barrier-free mounting heights for devices, conform to requirements of the governing code or regulation.
.4 Ensure that switches located adjacent to doors are located at the strike side of the door. Confirm door swings prior to roughing-in.

.5 Install single throw switches with the handle in the up position when the switch is closed.
.6 Confirm all switch, receptacle and faceplate types, colours and finishes prior to ordering.
.7 Provide a separate insulated ground conductor for each isolated ground receptacle
.8 Faceplates for computer equipment receptacles are to be permanently identified with “Computer Equipment Only” wording.
.9 Faceplates for housekeeping receptacles are to be permanently identified with “Housekeeping Only” wording.
.10 Do not install faceplates for flush devices until wall, etc., finishing work is complete.
.11 Where devices are to be installed in casework, millwork, or similar construction, carefully coordinate device installations and device openings with the trade providing the casework, millwork, etc.

3.2 WIRING DEVICE AND FACEPLATE TYPES & COLOURS

.1 Standard switches and receptacles in finished areas, non-essential circuits: white
.2 Switches and receptacles in unfinished areas, non-essential circuits with galvanized steel faceplates
.3 Faceplates materials: nylon.
.4 Faceplate colours; white

3.3 TESTING

.1 When installation is complete, test operation of all devices.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings / Product Data: Submit shop drawings and product data sheets for products specified in this Section. Ensure that the drawings and sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section.

.2 Panelboard Door Keys: Submit identified keys (minimum 6) for panelboards doors.

2 PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS

.1 General Re: Panelboards: Branch circuit panelboards are to be dead front, factory assembled panelboards designed for sequence phase connection of branch circuit breakers, as per the drawing schedule and plans, and in accordance with requirements of CAN/CSA-C22.2 No. 29, Panelboards and Enclosed Panelboards Industrial Products. Series rated combination of overcurrent protective devices are not acceptable. Each panelboard is to be complete with:

- .1 Silver plated, electrical grade, 95% conductivity copper bus mains for the full length of each enclosure
- .2 Main and branch circuit conductor solderless set-screw type lugs approved for copper conductors
- .3 Copper neutral bus and main lugs at the same end, and a removable cover for main lugs
- .4 Dedicated copper ground bus

.2 Panelboard Enclosures: Panelboard enclosures, unless otherwise specified, are to be EEMAC 2 sprinkler-proof, flush or surface mounted as indicated, constructed of Code gauge galvanized sheet steel, equipped with drip shields, and factory cleaned, primed, and finished with ASA-61 light gray equipment enamel. Each enclosure is also to be equipped with:

- .1 Wiring gutter space on all sides in accordance with CAN/CSA-C22.2 No. 29 requirements
- .2 Space for future breakers as applicable and as per the drawing panel schedules
- .3 A concealed hinged door and flush latch with keyed alike lock, and a frame with acetate cover and a circuit directory card on the inside face of the panel door

.3 Circuit Breakers: Breakers are to be moulded case, bolt-on breakers in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, calibrated for operation in a 40º C (105º F) ambient temperature, sized in accordance with the drawing schedules, and as follows:

- .1 Thermal magnetic type circuit breaker, quick-make, quick-break for manual and automatic operation for general purpose.
- .2 Current limiting, time-limit type quick-make, quick-break for manual and automatic operation for motor protection
- .3 Branch circuit breaker interrupting capacity is to suit the panelboard voltage and be as scheduled, and in accordance with OESC requirements to suit the application
- .4 For ground fault breakers, CSA Class A, Group 1 combination thermal magnetic trip breakers with solid-state ground fault interrupters
- .5 For breakers 200 amperes and larger, a solid-state adjustable trip unit with long time, short time, and instantaneous (LSI) time functions and time delays or long time, short time, instantaneous and ground fault (LSIG) and time delays where indicated, set at ratings in accordance with the distribution coordination study
- .6 For dedicated breakers, handle lock devices
- .7 As scheduled or shown, spare breakers and space for future breakers
- .8 Minimum 22kAIC.

.4 Modifications & Accessories: panelboards are to be factory equipped with modifications and accessories as follows:

- .1 a factory installed, maintenance free surge protective device (SPD) in accordance with ANSI/UL 1449 3rd Edition, connected to the bussing through a disconnect device and equipped with a diagnostic package with status indicators on each phase, LCD six digit surge

counter display, EMI/RFI filtering, audible alarm with silence button, and Form C alarm contacts 15PD shall not take up breaker spaces - extend boxes as required

.2 200% neutrals for panelboards equipped with SPD units and other panels as scheduled

.3 Sub-feed lugs

.4 Through-feed lugs

.5 Acceptable Manufacturers: Acceptable manufacturers are:

.1 Schneider Electric (Square D)

.2 Eaton Corp. (Cutler-Hammer)

.3 Siemens Electric Ltd.

.4 Or approved alternate

3 EXECUTION

3.1 INSTALLATION OF BRANCH CIRCUIT PANELBOARDS

.1 Provide branch circuit panelboards where shown. Ensure adequate operation and maintenance clearance on all sides of each panelboard as per Code requirements.

.2 Wall mount panelboards independent of connected conduit. Accurately install with reference to wall finish and confirm exact locations prior to roughing-in.

.3 Where two or more panelboards are installed in one enclosure equip the panelboards with double lugs and increase gutter capacity to accommodate additional cabling.

.4 For each GFI breaker demonstrate in the presence of the Consultant that the protected circuit will trip when a simulated ground fault is applied to the “load” side of the breaker, and megger the “load” side neutral to ensure that the neutral is not grounded on the “load “side of the GFI.

.5 From each recessed panel, except residential suite panels, and unless otherwise noted, provide minimum 2 @ 1" (25 mm) empty conduits up to accessible ceiling space directly above panel. Terminate each in a 4" (100 mm) square box with BM cover.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings / Product Data: Submit shop drawings and product data sheets for lighting fixtures and lamps. Ensure that the drawings and sheets indicate all features of the fixtures to confirm that the equipment is in accordance with requirements of this Section. Include:
- .1 certified fixture photometric data which includes total input watts, candlepower summary, candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, and lamp type and lumen rating in accordance with CSA IESNA testing procedures
- .2 ballast data such as maximum THD, power factor, and noise rating

1.2 QUALITY ASSURANCE

.1 All lighting fixtures and lamps are to be ULC listed and/or CSA certified and labeled.

2 PRODUCTS

2.1 GENERAL RE: LUMINAIRES AND LAMPS

.1 Luminaires and lamps are scheduled on the drawings.
.2 All luminaires (lighting fixtures) are to be suitable in all respects for the mounting locations indicated on the drawings, and are to be complete with all required mounting hardware.
.3 Unless otherwise specified, any fixture operated by means of a ballast must be equipped with its own ballast.
.4 Confirm exact colour and finish of luminaires at the submittals stage and prior to ordering.
.5 Lamps and ballasts for luminaires connected to dimmers are to be suitable in all respects for the application.

3 EXECUTION

3.1 INSTALLATION OF LUMINAIRES AND LAMPS

.1 General Installation Requirements:
- .1 Provide luminaires and lamps where shown. Include for all required site assembly, and provide all required installation and support hardware.
- .2 Confirm exact luminaires locations prior to roughing-in.
- .3 In finished areas, refer to architectural reflected ceiling plans and/or wall elevations.
- .4 In equipment rooms, shafts, and similar unfinished areas install luminaires after the equipment is roughed-in, and shelving and similar items are installed.
- .5 Prior to roughing-in for luminaire installations, examine drawings and site conditions to determine that suitable space is available for luminaire installations as shown. If sufficient space is not available, notify the Consultant immediately and , if required, relocate luminaires within reasonable distances without additional cost.
- .6 Locate recessed downlights, troffers, and surface mounted luminaires in or on suspended tile ceilings in or on full tiles. Where ceiling tile openings are cut for fixtures cut to exact sizes so that there are no gaps and fixture trim completely covers the perimeter of the opening.
- .7 Provide plaster frames for luminaires in suspended plaster or drywall ceilings.
- .8 Use clean gloves when handling reflector cones, louvers, halogen lamps, glass, sconces, and all exposed surfaces of fixtures.

3.2 SUSPENDED LUMINAIRES

.1 Support luminaires in suspended ceilings from the slab or building construction above independent of the suspended ceiling construction, with a minimum of two aircraft type cable supports and in accordance with requirements of governing Codes and Regulations.
.2 Support continuous rows of luminaires at minimum 1.2 m (48”) centres.
.3 Fixture support hardware in high humidity areas is to be corrosion resistant.

3.3 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted lines. Alignment variation is not to exceed 6 mm (¼") in any 5 m (16') run.
.2 Align luminaires mounted individually parallel and/or perpendicular to building lines.
.3 Aim accent and spot lighting as indicated and/or as directed by the Consultant, and secure the fixture positions after the Consultant's approval.

3.4 LAMPS

.1 Provide new lamps for each luminaire.
.2 Include a full listing of lamps in O & M Manuals.
.3 At Substantial Performance, replace all lamps used for construction lighting.
.4 Operate all lamps to be dimmed for a "settling down" period of a continuous one hundred hour burn or by ten-hour continuous burns, unless otherwise recommended by the lamp manufacturer, in which case follow the lamp manufacturer's recommendations.

3.5 LUMINAIRE CIRCUIT WIRING

.1 Connect luminaires to circuits indicated with wiring as specified.

3.6 CLEANING

.1 When all luminaire installation work is complete, clean all luminaries and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the luminaire installation work.
.2 If wall and ceiling surfaces are damaged as a result of the luminaire installation, replace the wall or ceiling surface to the Consultant's approval.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings / Product Data: Submit shop drawings and product data sheets for lighting fixtures, lamps, mounting brackets and poles. Ensure that the drawings and sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section. Include:
- .1 Certified horizontal and vertical beam spread, beam lumens, beam efficiency, and complete photometric data
- .2 Ballast data such as maximum THD, power factor, and noise rating
- .3 For pole mounted fixtures, submit documentation to confirm that the poles proposed are suitable for the steady wind velocity and wind gust velocity data for the area of installation, and for the total weight and projected area of the luminaires.
- .4 Submit complete design and construction shop drawings for pole mounted fixtures and concrete bases, prepared, stamped and signed by a Professional Structural Engineer registered in the place of the work

1.2 QUALITY ASSURANCE

.1 All lighting fixtures and lamps are to be ULC listed and/or CSA certified and labeled.
.2 High intensity discharge lamp ballasts are to conform to ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium lamps.

2 PRODUCTS

2.1 GENERAL RE: LUMINAIRES AND LAMPS

.1 Luminaires and lamps are scheduled on the drawings.
.2 All luminaires (lighting fixtures) are to be completely weatherproof, non-corrosive, suitable in all respects for the mounting locations indicated on the drawings, and are to be complete with all required mounting hardware.
.3 Unless otherwise specified, any fixture operated by means of a ballast must be equipped with its own ballast.
.4 Confirm exact colour and finish of luminaires at the submittals stage and prior to ordering.

2.2 POLES

.1 Steel Poles: Hot dipped galvanized, minimum 4.5 mm (3/16”) thick steel, round or octagonal monotube style poles sized as indicated on the drawings, designed for underground wiring and mounting on a concrete base. Unless otherwise specified poles are to be tapered and complete with an access hand hole with frame and cover for wiring connections 450 mm (18”) above grade, a minimum of four non-corrosive anchor bolts and nuts with shims and tamper-proof covers, and a suitably sized grounding lug.
.2 Aluminum Poles: G063-T6 aluminum, minimum 4.5 mm (3/16”) thick, round or octagonal monotube style poles sized as indicated on the drawings, designed for underground wiring and mounting on a concrete base. Unless otherwise specified poles are to be tapered and complete with an access hand hole with frame and cover for wiring connections 450 mm (18”) above grade, a minimum of four non-corrosive anchor bolts and nuts with shims and tamper-proof covers, and a suitably sized grounding lug.

2.3 LUMINAIRE MOUNTING BRACKETS

.1 Corrosion-resistant metal brackets, cantilevered without under-braces, of sizes and styles specified with the luminaires they are required for, and complete with all required non-corrosive mounting and connection hardware.

3 EXECUTION

3.1 INSTALLATION OF EXTERIOR LUMINAIRES AND LAMPS

.1 Provide exterior luminaires and lamps where shown. Include for all required site assembly, and provide all required installation and support hardware.
.2 Confirm exact luminaire locations prior to roughing-in.
.3 Secure grade mounted building floodlighting fixtures to concrete pads set flush with finished grade.

3.2 INSTALLATION OF LUMINAIRE POLES

.1 Provide poles with luminaire mounting brackets for pole mounted luminaires.
.2 For direct bury concrete poles backfill the excavation around the pole with concrete.
.3 Secure metal poles to reinforced concrete bases. Install pole anchor bolt support hardware in the base concrete during the pour, and ensure that the hardware is properly positioned and remains properly positioned until concrete has set. Provide vandal-proof anchor bolt covers.
.4 Refer to the pole concrete base detail indicated on the drawings.
.5 Ensure that all poles are true and plumb.

3.3 CONCRETE, EXCAVATION AND BACKFILL WORK

.1 Carefully coordinate concrete and excavation and backfill work with the trades performing the work.
.2 Perform all required concrete and excavation and backfill work in accordance with requirements of Division 03 and Division 31.

3.4 LUMINAIRE ALIGNMENT

.1 Aim and align building floodlighting and/or spotlighting during evening hours under the direction and to the approval of the Consultant, and secure the fixture positions after the Consultant’s approval.

3.5 LAMPS

.1 Provide new lamps for each luminaire.
.2 Include a full listing of lamps in O & M Manuals.
.3 At Substantial Performance, replace all lamps used for construction lighting.

3.6 LUMINAIRE CIRCUIT WIRING

.1 Connect luminaires to circuits indicated with wiring as specified. Install wiring in conduit.
.2 Connect metal parts of poles with ground conductors connected to the building grounding system.

3.7 CLEANING

.1 When all luminaire installation work is complete, clean all luminaires and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the luminaire installation work.
.2 If wall and ceiling surfaces are damaged as a result of the luminaire installation, replace the wall or ceiling surface to the Consultant’s approval.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for exit lighting fixtures and lamps. Ensure that the drawings and sheets indicate all features of the fixtures to confirm that the equipment is in accordance with requirements of this Section.

1.2 QUALITY ASSURANCE

.1 All exit lighting fixtures are to be CSA certified in accordance with:
  .1 CSA C22.2 No. 141, Unit Equipment for Emergency Lighting
  .2 CSA C860, Performance of Internally-Lighted Exit Signs

2 PRODUCTS

2.1 EXIT LIGHTS – SELF-POWERED UNITS

.1 Housing: cold rolled steel min 1.0 mm thick, satin aluminum enamel finish, painted factory white.
.2 University mounting: end, wall or ceiling
.3 Face plate: constructed of extruded aluminum with knock-out directional chevrons and baked white enamel finish.
.4 150 mm (6” high) 20mm (3/4”) wide, “running man” pictogram film with directional arrow.
.5 Legend illuminated by white LED lamp (6v – 27w)
.6 Operation: Designed for over 100,000 hours of continuous operation without relamping.
.7 Power: 120 vac supply,6vdc output
.8 Operating time: minimum 90 minutes
.9 Sealed, maintenance free battery
.10 Twin 6V-4W LED Remote Head
.11 10-year warranty
.12 Acceptable manufacturers are:
  .1 Canlyte Inc. “Uniglo”
  .2 Lumacell Inc.
  .3 Emergi-Lite Ltd.
  .4 Hubbell Inc. “Dual-Lite”
  .5 Luxnet Corp.
  .6 Beghelli
  .7 Philips “Lightguard”
  .8 Stanpro
  .9 Or approved alternate

3 EXECUTION

3.1 INSTALLATION OF EXIT LIGHTS

.1 Provide exit lights where shown. Include for all required site assembly and provide all required installation and support hardware.
.2 Confirm exact exit light locations prior to roughing-in.
.3 Connect exit lights to circuits indicated with wiring as specified. Install wiring in conduit. Ensure that panelboard breakers serving exit lights are equipped with lock-on devices.
.4 Provide all required lamps.
.5 When all exit light installation work is complete, clean all fixtures and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the installation work.
.6 If wall and ceiling surfaces are damaged as a result of the installation, replace the wall or ceiling surface to the Consultant’s approval.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for emergency lighting. Ensure that the drawings and sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section. Include complete battery charger data, and battery charge and discharge voltage/time characteristics.

.2 Battery Warranty: Submit a copy of the battery warranty specified below, and include a copy in the O & M Manual.

.3 Letter of Certification: As per Part 3 of this Section, submit a letter from the representative of the emergency lighting manufacturer to certify that the installation has been tested and adjusted and operates as intended.

1.2 QUALITY ASSURANCE

.1 All emergency lighting is to be CSA certified in accordance with:

- .1 CSA C22.2 No. 141, Unit Equipment for Emergency Lighting
- .2 CSA C22.2 No. 107.2, Battery Chargers
- .3 UL 924, Standard for Emergency Lighting and Power Equipment

1.3 WARRANTY

.1 For batteries, the Contract warranty is to be extended to ten years with no-charge replacement during the first five years, and a pro-rate charge during the last five years. Submit a copy of the warranty in the name of the Owner.

2 PRODUCTS

2.1 SELF-CONTAINED EMERGENCY LIGHTING INVERTERS

.1 Solid-state, factory assembled and tested, 120 volt AC input, 12 volt DC output, battery operated emergency lighting mini inverter units, each capable of supplying the load for the length of time indicated on the drawings (minimum 30 minutes), and to automatically shut-off. Each unit is to be complete with:

- .1 a white enamelled steel cabinet suitable for shelf or direct wall mounting, with conduit knock-outs and a removable or hinged front panel for battery access
- .2 white enamelled steel mounting and support hardware to suit installation locations indicated
- .3 a sealed, maintenance-free battery in a high-impact, heat resistant translucent plastic casing
- .4 a multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected solid state pulse type battery charger with a regulated output of ± 0.01 volts for ± 10% input variations, transfer circuit, solid-state modular low voltage disconnect to operate at 80% battery output voltage, and a suitable length of 3-wire power cord with “twist-lock” plug
- .5 signal lights for “AC POWER ON” and red “HIGH CHARGE”, an ammeter and a voltmeter, a test switch, time delay relay, battery disconnect device, RFI suppressors, and AC input and DC output terminal blocks inside the cabinet
- .6 Lumacell Inc. Model LMI Mini-Inverter Series Interruptible Unit equipment or equivalent by Emergi-Lite (Series EMIU), Stanpro (Series SNV) or Aim-Lite, or approved alternate.

2.2 SELF-CONTAINED EMERGENCY LIGHTING UNITS

.1 Solid-state, factory assembled and tested, 120 volt AC input, 12 volt DC output, battery operated emergency lighting units, each capable of supplying the load for the length of time indicated on the drawings, and to automatically shut-off. Each unit is to be complete with:

- .1 a white enamelled steel cabinet suitable for shelf or direct wall mounting, with conduit knock-outs and a removable or hinged front panel for battery access
- .2 white enamelled steel mounting and support hardware to suit installation locations indicated

.3 a sealed, maintenance-free battery in a high-impact, heat resistant translucent plastic casing
.4 a multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected solid state pulse type battery charger with a regulated output of ± 0.01 volts for ± 10% input variations, transfer circuit, solid-state modular low voltage disconnect to operate at 80% battery output voltage, and a suitable length of 3-wire power cord with "twist-lock" plug
.5 signal lights for "AC POWER ON" and red "HIGH CHARGE", an ammeter and a voltmeter, a test switch, time delay relay, battery disconnect device, RFI suppressors, and AC input and DC output terminal blocks inside the cabinet
.6 cabinet mounted, dual, adjustable (345º horizontal and 180º vertical) lamp heads, integral with the cabinet and/or remote mounting as indicated, each complete with a 4W, LED glare-free lamp, minimum
.7 Lumacell Inc. Model MQM1-LD7 remote surface mounted Dual or Single (per drawings) lamp head with a 12 volt DC 4 watt LED lamp or equivalent by Emergi-Lite, Dual-Lite, Light Guard, Beghelli, Stanpro

.2 Acceptable manufacturers are:
.1 Lumacell Inc. Model RG12S [ ] or equal by:
.1 Emergi-Lite Ltd.
.2 Hubbell Inc. "Dual-Lite"
.3 Philips "LightGuard"
.4 Beghelli
.5 Stanpro
.6 Or approved alternate

3 EXECUTION

3.1 INSTALLATION OF EMERGENCY LIGHTING INVERTERS

.1 Provide self-contained emergency lighting inverters where shown. Include for all required site assembly, provide all required installation and support hardware, and plug the assemblies into adjacent receptacles. Confirm exact locations prior to installation.
.2 Install and connect lighting to the battery unit with conductors (sized as indicated) in conduit. Ensure that panelboard breakers serving battery units are equipped with lock-on devices.
.3 When all installation work is complete, clean all battery units, and any ceiling, wall, etc., surfaces soiled as a result of the installation work.
.4 If wall and ceiling surfaces are damaged as a result of the installation, replace the wall or ceiling surface to the Consultant's approval.
.5 Test operation of each battery unit, including charge rate after discharge, in the presence of the manufacturer's representative, and submit a letter from the manufacturer's representative to certify that all battery units and lamp heads have been tested and operate as intended.

3.2 INSTALLATION OF SELF-CONTAINED EMERGENCY LIGHTING UNITS

.1 Provide self-contained emergency lighting units where shown. Include for all required site assembly, provide all required installation and support hardware, and plug the assemblies into adjacent receptacles. Confirm exact locations prior to installation.
.2 Where remote lamp heads are indicated, install and connect to the battery unit with conductors (sized as indicated) in conduit. Ensure that panelboard breakers serving battery units are equipped with lock-on devices.
.3 Provide all required heads
.4 Aim all adjustable lamp heads to the Consultant's approval.
.5 When all installation work is complete, clean all battery units, lamp heads, and lamps, and any ceiling, wall, etc., surfaces soiled as a result of the installation work.
.6 If wall and ceiling surfaces are damaged as a result of the installation, replace the wall or ceiling surface to the Consultant's approval.
.7 Test operation of each battery unit, including charge rate after discharge, in the presence of the manufacturer's representative, and submit a letter from the manufacturer's representative to certify

that all battery units and lamp heads have been tested and operate as intended.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for heating cable and control. Ensure that the drawings and sheets indicate all features of the cable and control to confirm that the products are in accordance with requirements of this Section. Include installation instructions and certified power and control wiring diagrams.

.2 Manufacturer's Inspection & Certification Letters: Submit a letter from the cable manufacturer to confirm that the manufacturer has inspected the completed cable installation and found it acceptable.

1.2 QUALITY ASSURANCE

.1 Heating cable and control components are to be in accordance with requirements of CAN/CSA C22.2 No. 130, Requirements for Electrical Resistance Heating Cables and Heating Device Sets.

2 PRODUCTS

2.1 PIPE FREEZE PROTECTION HEATING CABLE

.1 Raychem Canada Ltd. "XL-Trace-CR" self-regulating heating cable sets as per the drawing schedule, each set complete with:
- .1 The required lengths of "XL-Trace" heating cable
- .2 A power connection with end seal per circuit
- .3 Tee connections with end seals for piping branches as required
- .4 Splice connections as required
- .5 GT-66 glass tape to secure cable on the pipe, and "Electric Traced adhesive labels for site installation on the pipe insulation
- .6 A pipe temperature sensing thermostat

.2 Acceptable manufacturers are:
- .1 Raychem Canada Ltd.
- .2 Dimplex/Chromalox
- .3 Pyrotenax
- .4 Or approved alternate

3 EXECUTION

3.1 GENERAL RE: INSTALLATION OF HEATING CABLE

.1 Do not install heating cable until the piping has been successfully pressure tested.

.2 Refer to mechanical drawings for sizes and general routing of piping to be traced with cable. Include for providing cable on all piping components such as valves, strainers, etc., indicated, and confirm pipe sizes and routing on site prior to ordering cable sets.

.3 Unless otherwise shown or specified, conform to the cable manufacturer's installation instructions.

.4 After piping has been insulated and identification is in place, affix "Electrically Traced" labels on opposite sides of the pipe at each point of pipe identification.

3.2 INSTALLATION OF PIPE FREEZE PROTECTION HEATING CABLE

.1 Provide all required freeze protection heating cable sets for piping as shown.

.2 After cable installation but before pipe insulation, and with the manufacturer's representative in attendance at the site, meggar test the cable and test and confirm operation of control components. Replace any damaged or faulty cable.

.3 Obtain from the cable manufacturer and submit as specified in Part 1 of this Section, a letter stating that the cable installation has been reviewed and is properly installed, has been successfully meggar tested, and that all control components are fully operational.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Requirements of Section 26 03 00.

1.2 MECHANICAL-ELECTRICAL EQUIPMENT SCHEDULE

.1 The following Mechanical-Electrical Equipment Schedule is provided to assist the Contractor in coordinating the efforts of sub-trades. The assignment of work among subcontractors is the Contractor's responsibility and the Contractor is free to amend the schedule as he sees fit.

.2 The Mechanical-Electrical Equipment Schedule also describes work that is required and may or may not be described elsewhere. All work indicated in the Mechanical-Electrical Equipment Schedule shall be included in the Bid Price.

.3 The Mechanical-Electrical Equipment Schedule shall not limit the extent of the Contract in any way. Work indicated elsewhere or otherwise needed for a complete and functioning installation shall be provided whether or not shown in the Mechanical-Electrical Equipment Schedule.

1.3 RESPONSIBILITY CODES

.1 Responsibility Codes in the Mechanical-Electrical Equipment Schedule shall be interpreted as follows

.1 "Supplied by Div." means that the equipment is to be supplied to the site under the Division described by number.

.2 "Installed by Div." means that the equipment is to be received from the supplier, handled, set in place and installed at the site under the Division described by number.

.3 "Wired and connected by Div." means that the equipment and its associated devices are to be wired and connected to the various electrical systems in accordance with the equipment manufacturer's installation instructions and wiring diagrams under the Division described by number.

END OF SECTION

Mechanical / Electrical Schedule

No.	Equipment				Controls			Responsibility		
	Item	Characteristics		Service / Location	Type	Location	Manufacturer's Reference	Supplied by Div.	Installed By Div.	Wired & Connected by Div.
1	Rooftop Unit RTU-1 (Admin Area)	FLA	25	High Roof	Disconnect	Integral to VFD	See Mech Spec	23	23	26
		MCA	31		VFD	At RTU	See Mech Spec	23	23	26
		MOCP	35		BAS	TBD on Site	See Spec	25	25	25
		Supply HP	1 x 2HP		Other Controls	See Drawings	See Mech Spec	23	23	23
		Exhaust HP	1 x 1HP		Fire Alarm Relay	at VFD	See Spec	26	26	26
		Voltage	575							
		Phase	3							
		Freq.	60							
	Rooftop Unit Receptacle	Amps	20	Refer to Electrical Drawings	Receptacle	At RTU	Weatherproof cove	26	26	26
		Voltage	120							
		Phase	1							
		Freq.	60							
	Single point of electrical connection. Co-ordinate fire alarm relay between M&E sub-Contractors and CAN/ULC S524.									
2	Rooftop Unit RTU-2 (Cats Intake Area)	FLA	45	Low Roof	Disconnect	Integral to VFD	See Mech Spec	23	23	26
		MCA	56		VFD	At RTU	See Mech Spec	23	23	26
		MOCP	60		BAS	TBD on Site	See Spec	25	25	25
		Supply HP	1 x 2HP		Other Controls	See Drawings	See Mech Spec	23	23	23
		Exhaust HP	1 x 1HP		Fire Alarm Relay	at VFD	See Spec	26	26	26
		Voltage	575							
		Phase	3							
		Freq.	60							
	Rooftop Unit Receptacle	Amps	20	Refer to Electrical Drawings	Receptacle	At RTU	Weatherproof cove	26	26	26
		Voltage	120							
		Phase	1							
		Freq.	60							
	Single point of electrical connection. Co-ordinate fire alarm relay between M&E sub-Contractors and CAN/ULC S524.									
3	Rooftop Unit RTU-3 (Adoption Area)	FLA	69	Low Roof	Disconnect	Integral to VFD	See Mech Spec	23	23	26
		MCA	72		VFD	At RTU	See Mech Spec	23	23	26
		MOCP	80		BAS	TBD on Site	See Spec	25	25	25
		Supply HP	1 x 5HP		Other Controls	See Drawings	See Mech Spec	23	23	23
		Exhaust HP	1 x 2HP		Fire Alarm Relay	at VFD	See Spec	26	26	26
		Voltage	575							
		Phase	3							
		Freq.	60							
	Rooftop Unit Receptacle	Amps	20	Refer to Electrical Drawings	Receptacle	At RTU	Weatherproof cove	26	26	26
		Voltage	120							
		Phase	1							
		Freq.	60							
	Single point of electrical connection. Co-ordinate fire alarm relay between M&E sub-Contractors and CAN/ULC S524.									
4	Rooftop Unit RTU-4 (Dogs Intake Area)	FLA	59	Low Roof	Disconnect	Integral to VFD	See Mech Spec	23	23	26
		MCA	62		VFD	At RTU	See Mech Spec	23	23	26
		MOCP	70		BAS	TBD on Site	See Spec	25	25	25
		Supply HP	1 x 5HP		Other Controls	See Drawings	See Mech Spec	23	23	23
		Exhaust HP	1 x 2HP		Fire Alarm Relay	at VFD	See Spec	26	26	26
		Voltage	575							
		Phase	3							
		Freq.	60							
	Rooftop Unit Receptacle	Amps	20	Refer to Electrical Drawings	Receptacle	At RTU	Weatherproof cove	26	26	26
		Voltage	120							
		Phase	1							
		Freq.	60							
	Single point of electrical connection. Co-ordinate fire alarm relay between M&E sub-Contractors and CAN/ULC S524.									
5	Heating Heat Pump HP-1	MCA	70	High Roof	Disconnect	At Unit	See elec spec	26	26	26
		MOCP	90		Other Controls	See Dwgs.	See spec	23	23	23
		Voltage	575		BAS	TBD on Site	See spec	25	25	25
		Phases	3							
		Freq.	60							
		kW	31.8							

6	Primary Heat Pump Circulator P-4	HP	1	Mechanical / Electrical Room	Disconnect	In VFD	See mech spec	23	23	26
		Voltage	208		VFD	At Unit	See mech spec	23	23	26
		Phase	1		Other Controls	See Dwgs.	See spec	23	23	25
		Freq.	60		Alarms	See spec	See spec	25	25	25
					BAS	TBD on Site	See spec	25	25	25
					VFD complete with HOA and red pilot light in cover			23	23	26
7	Primary Boiler Pump P-3	HP	1/6	Mechanical / Electrical Room	Disconnect	In VFD	See mech spec	23	23	26
		Voltage	115		VFD	At Unit	See mech spec	23	23	26
		Phase	1		Other Controls	See Dwgs.	See spec	23	23	25
		Freq.	60		Alarms	See spec	See spec	25	25	25
					BAS	TBD on Site	See spec	25	25	25
					VFD complete with HOA and red pilot light in cover			23	23	26
8	Main Circulation Pump P-2A & P-2B	HP	1	Mechanical / Electrical Room	Disconnect	In VFD	See mech spec	23	23	26
		Voltage	208		VFD	At Unit	See mech spec	23	23	26
		Phase	1		Other Controls	See Dwgs.	See spec	23	23	25
		Freq.	60		Alarms	See spec	See spec	25	25	25
					BAS	TBD on Site	See spec	25	25	25
					VFD complete with HOA and red pilot light in cover			23	23	26
9	Electric Boiler B-1	Voltage	600	Mechanical / Electrical Room	Disconnect (WP)	Integral to Unit	See Mech Spec	23	23	26
		Phases	3		Other Controls	See Mech Dwgs	See Mech Spec	23	23	23
		Freq.	60		BAS	TBD on Site	See Spec	25	25	25
		kW	70							
10	Exhaust Fan EF-1 (Dog Isolation)	HP	1 x 1/8HP	Low Roof	Disconnect (WP)	Integral to VFD	See Mech Spec	23	23	26
		Voltage	115		VFD	See Mech Dwgs	See Mech Spec	23	23	26
		Phases	1		Motorized Damper	At Roof	See Spec	23	23	25
		Freq.	60		RPM	See Mech Dwgs	See Spec	25	25	25
					Other Controls	See Mech Dwgs	See Mech Spec	23	23	23
					BAS	TBD on Site	See Spec	25	25	25
12	Exhaust Fan EF-2 (Cat Isolation)	HP	1 x 1/8HP	Low Roof	Disconnect (WP)	Integral to VFD	See Mech Spec	23	23	26
		Voltage	115		VFD	See Mech Dwgs	See Mech Spec	23	23	26
		Phases	1		Motorized Damper	At Roof	See Spec	23	23	25
		Freq.	60		RPM	See Mech Dwgs	See Spec	25	25	25
					Other Controls	See Mech Dwgs	See Mech Spec	23	23	23
					BAS	TBD on Site	See Spec	25	25	25
13	Exhaust Fan EF-3 Mechanical / Electrical Room Exhaust	HP	1 x 1/8HP	Mechanical / Electrical Room	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Phases	1		Other Controls	See Dwgs.	See spec	23	23	23
		Freq.	60		Motorized Damper	In Duct	See spec	23	23	25
					BAS	TBD on Site	See spec	25	25	25
					Starter complete with HOA and red pilot light in cover					
14	Exhaust Fan EF-4 Receiving Bay Safety Exhaust	HP	1 x 1/8HP	Receiving Bay	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Phases	1		Other Controls	See Dwgs.	See spec	23	23	23
		Freq.	60		Motorized Damper	In Duct	See spec	23	23	25
					BAS	TBD on Site	See spec	25	25	25
					Starter complete with HOA and red pilot light in cover					
15	Exhaust Fan EF-5 Wild Life Room	Watts	11.1W	Wild Life Room	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Amps	0.26 A		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Other Controls	See Dwgs.	See spec	23	23	23
		Phases	1		Motorized Damper	In Duct	See spec	23	23	25
		Freq.	60		BAS	TBD on Site	See spec	25	25	25
					Starter complete with HOA and red pilot light in cover					
16	Exhaust Fan EF-6 Washroom	Watts	23.3W	Staff Washroom	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Amps	0.3 A		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Other Controls	See Dwgs.	See spec	23	23	23
		Phases	1							
		Freq.	60							
17	Exhaust Fan EF-7 Washroom	Watts	23.3W	Universal Washroom	Disconnect	See Dwgs.	See Elec Spec.	26	26	26
		Amps	0.3 A		Starter	See Dwgs.	See Elec Spec.	26	26	26
		Voltage	115		Other Controls	See Dwgs.	See spec	23	23	23
		Phases	1							
		Freq.	60							
18	Cabinet Unit Heater CUH-1, 2, 3, 4, 5, 6	Fans	1/10HP	See Drawings for Number and Locations	Disconnect	At Unit	See Elec Spec	26	26	26
		Amps	1.7A		Controller	At Unit	See Mech Spec	23	23	26
		Voltage	120		Thermostat	See Drawings	See Mech Spec	25	25	25
		Phases	1		Other Controls	See Drawings	See Spec	23	23	23
		Freq.	60							
19	Unit Heaters UH-1, 2, 3, 4	HP	1 x 1/8HP	See Drawings	Starter	See Dwgs.	See Mech Spec	26	26	26
		Amps	1.35A		Thermostat	See Dwgs.	See Mech Spec	25	25	25
		Voltage	120		Disconnect	At unit	See Elec Spec	26	26	26
		Phases	1		Other Controls	See Dwgs.	See Spec	23/25	23/25	23/25
		Freq.	60							
20	Electronic Trap Seal Primer Manifold and Mini	Amp	15	See Drawings	24 VAC Direct Connection	At unit	See elec spec	22	22	26
		Voltage	120							
		Phase	1							
		Freq.	60							
21	Domestic Hot Water Heater - Hybrid Heat Pump/Electric DHWH-1 & 2	Amp	30A	See Drawings	Direct Connection	See elec dwgs	See elec spec	26	26	26
		Voltage	208		Disconnect	At unit	See mech spec	22	22	26
		Phases	1		BAS	TBD on Site	See spec	25	25	25
		Freq.	60							
22	Domestic Hot Water Recirc Pump P-1	HP	1/6	Mechanical / Electrical Room	Disconnect	See starter	See Starter	26	26	26
		Voltage	120		Starter	At unit	AB#512 series	26	26	26
		Phases	1		Other Controls	By unit	See mech spec	22	22	22
		Freq.	60							

23	Motorized Damper	Voltage	120	See Dwgs	Damper	See Dwgs.	See Mech Spec	25	23	25
		Phases	1		Actuator	See Dwgs.		25	25	25
		Freq.	60		Contols/BAS			25	25	25
24	Glycol Fill Station	Watts	50	Mechanical / Electrical Room	Plug in	At unit	See spec	23	26	26
		Voltage	120		Other Controls	See Dwgs.	See spec	23	23	23
		Phase	1							
		Freq.	60							

1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and conform to:
  .1 The Contract CCDC 2-2020, Stipulated Price Contract as amended in the Contract Documents
  .2 Division 1 requirements and documents referred to therein.

.2 The Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.2 BASIC MATERIALS AND METHODS

.1 Conform to all Sections of Division 26.
.2 Provide complete and operational system components and wiring as indicated.

1.2 SUMMARY

.1 The Electrical Contractor is to retain a qualified Cabling Contractor (hereafter referred to as the CC) for the supply and installation of a structured telecommunications cabling system. The installation must be designed in accordance with, and supported by, a manufacturers backed warranty certification as specified herein.
.2 Equipment, materials, labour, and services to be provided by the CC include, but are not limited to, the supply and installation of:
  .1 Telecommunications Rooms
  .2 Raceway, boxes, and cable tray
  .3 Telephone and data cabling
  .4 Telecommunications outlets
  .5 Terminal blocks/cross-connect systems
  .6 Equipment racks and cabinets
  .7 System testing, and
  .8 Documentation and submissions
.3 The CC is to provide all equipment, materials, labour, and services, not specifically mentioned or shown, which may be necessary to complete or perfect all parts of the installation. The CC is to ensure that all equipment, materials, labour, and services are in compliance with requirements stated or reasonably inferred by the contract documents.

1.3 REFERENCES

.1 The CC is to design, manufacture, test, and install structured telecommunications cabling systems as per manufacturer's requirements and in accordance with NFPA-70 (National Electrical Code®), federal, provincial and local codes, requirements of authorities having jurisdiction, the Client Technical Authority and particularly the following standards (and their current addendums):
  .1 ANSI/NECA/BICSI-568 -- Standard for Installing Commercial Building Telecommunications Cabling
  .2 ANSI/TIA/EIA Standards:
    .1 ANSI/TIA/EIA-568-B.1 -- Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements
    .2 ANSI/TIA/EIA-568-B.2 -- Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components
    .3 ANSI/TIA/EIA-569-A -- Commercial Building Standard for Telecommunications Pathways and Spaces
    .4 ANSI/TIA/EIA-606(A) -- The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
    .5 ANSI/TIA/EIA-607(A) -- Commercial Building Grounding and Bonding Requirements for Telecommunications
    .6 ANSI/TIA/EIA-758(A) -- Customer-Owned Outside Plant Telecommunications Cabling

Standard

.2 Install cabling in accordance with the most recent installation requirements.

.3 Federal, provincial, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached. If the contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the Client Technical Authority in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

.4 Products, devices, equipment, cabling and related hardware shall be provided in accordance with the City of Brantford Network Cabling Specifications.

1.4 PERMITS, FEES, AND CERTIFICATES OF APPROVAL

.1 As prerequisite to final acceptance, the CC may be required to supply to the owner certificates of inspection from an inspection agency acceptable to the owner and approved by local municipality and utility company serving the project.

1.5 SYSTEM DESCRIPTION

.1 The telecommunications cabling plant shall be designed to provide voice (VoIP) and data services throughout the facility. The cabling system shall be standards compliant and composed of the following interdependent sub-systems:

- .1 (MC) Main Cross-connect System (located in Equipment Room)
- .2 (IC) Intermediate Cross-connect System
- .3 (WA) Work Area (outlet, jacks, associated cords and adapters)
- .4 (HC) Horizontal Cross-connect System (HC) (located in the Telecommunications Room)
- .5 (A,B,C) Backbone Cable
- .6 (D) Horizontal

.2 Cabling sub-system distances must conform to the limitations of the Standards.

.3 The Horizontal Cable Plant Infrastructure shall be supplied and installed as per the drawings.

.4 This infrastructure can be described as follows:

- .1 "B" Network switches will be supplied and installed in the 19" Rack by the owner.
- .2 "C" contractor is to supply sufficient patch cords to patch down all outlets in this contract plus 10% spares. Patch cables will be installed by the owner when the network switches are installed.
- .3 "D" contractor is to terminate all cables in patch panel, test and label. Voice outlets shall be separated from data outlets, i.e. separate patch panels.

.5 Equipment Cable fields will consist of Voice and Data systems.

.6 A telecommunications cabling infrastructure generally consists of two telecommunications outlets in each workstation (WA), wall telephones in common and mechanical areas. Telecommunications Room (TR) located on the second floor.

.7 The typical workstation consists of a single-gang plate or furniture adapter plate with two Category 6 standard compliant work area jacks. One work area jack will provide voice service, the other work area jack will provide data service.

.8 Each work area jack consists of one (1) four-pair data Category 6 cable installed from work area outlet to the TR. Terminate voice and data cables on patch panel in rack located in the appropriate TR.

1.6 QUALITY ASSURANCE

.1 To provide continuity of material cabling systems are approved for use on this project. To provide continuity of material, relay racks are approved for use on this project.

.2 The contractor shall be an authorized as per section 1.1(Certified System Vendor).

.3 The contractor shall have worked satisfactorily for a minimum of five (5) years on systems of this type and size.

.4 Equipment and materials of the type for which there are independent standard testing requirements, listings, and labels, shall be listed and labelled by the independent testing laboratory.

.5 Where equipment and materials have industry certification, labels, or standards (i.e., NEMA - National Electrical Manufacturers Association), this equipment shall be labelled as certified or complying with

standards.

.6 Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout.

.7 Subcontractors shall assume all rights and obligations toward the contractor that the contractor assumes toward the owner and engineer/designer.

1.7 WARRANTY

.1 Upon completion of the project the CC shall provide to the Client Technical Authority a 15 year Manufacturers Component Warranty and Lifetime Application Assurance Warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Protect material during transit, storage, and handling to prevent damage, theft, soiling, and misalignment. Coordinate with the owner for secure storage of materials. Do not store material where conditions fall outside manufacturer's recommendations for environmental conditions.

.2 Do not install damaged material; remove from site and replace damaged material with new material.

1.9 SEQUENCE AND SCHEDULING

.1 Submit a detailed schedule for installation of the cable plant infrastructure. Indicate delivery, installation, and testing for conformance to specific job completion dates. As a minimum, dates are to be provided for bid award, installation start date, completion of station cabling, completion of riser cabling, completion of testing and labelling, cut-over, completion of the final connection list, start of demolition, owner acceptance, and demolition completion. This schedule is to be co-ordinated with the overall construction schedule.

1.10 CONTINUITY OF SERVICES

.1 Take no action that will interfere with, or interrupt, existing building services unless previous arrangements have been made with the owner's representative. Arrange the work to minimize shutdown time.

.2 Owner's personnel will perform shutdown of operating systems. The contractor shall give three (3) days' advance notice for systems shutdown.

.3 Should services be inadvertently interrupted, immediately furnish labour, including overtime, material, and equipment necessary for prompt restoration of interrupted service.

1.11 SUBMITTALS

.1 The CC shall submit as part of the evaluation package the following:

.2 Qualification of CC: Submit the following:

.1 The CC shall show proof of a contractual relationship with the manufacturer, and shall be authorized to pass through the manufacturers warranty to the Client Technical Authority.

.2 The CC, will accept complete responsibility for the design, installation, certification, and support of the cabling system. The CC must show proof that vendor has the certifying manufacturer's support on all of these issues

.3 The Telecommunications Technicians employed by the CC shall be fully trained and qualified by the manufacturer on the installation and testing of the equipment to be installed. The CC shall provide a list of Technicians assigned to install the infrastructure and provide proof of the Technicians successful training by the manufacturer.

.4 The CC shall have experience in installing cabling systems as evidenced with a listing of at least 3 projects involving Category 6 which have been completed by the CC in the last two (2) years. Names, addresses and phone numbers of referenced projects shall be included. These projects shall be certified systems of the same manufacturer described herein.

.2 General: Submit the following:

.1 A complete Bill of Materials, including manufacturer, part numbers, and description. Note long lead time items.
.2 A project schedule including all major work components that materially affect any other work on the project. Refer to article - SEQUENCE AND SCHEDULING herein.

.3 Shop drawings: Submit the following:
.1 Backbone (riser) diagrams.
.2 System block diagram, indicating interconnection between system components and sub-systems.
.3 Interface requirements, including connector types and pin-outs, to external systems and systems or components not supplied by the contractor.
.4 Product Data - If required by the Client Technical Authority provide catalogue cut sheets and information for the following:
.1 Wire, cable
.2 Outlets, jacks, face plates, and connectors
.3 All metallic and nonmetallic raceways, including surface raceways, outlet boxes, and fittings
.4 Terminal blocks and patch panels
.5 Enclosures, racks, and equipment housings
.6 Other items as requested

.3 The CC shall submit at the conclusion of the project or project phase the following:
Project records:
.1 Submit project record as-built drawings at conclusion of the project and include in both soft and hard copy:
.1 Approved shop drawings
.2 Plan drawings indicating locations and identification of work area outlets, nodes, telecommunications rooms (TRs), and backbone (riser) cable runs
.3 In each TR provide one (1) full sized laminated as-built drawing indicating the locations and identification of work area outlets serviced from that particular TR.
.2 Submit project cable plant infrastructure administrative records at conclusion of the project and include in both soft and hard copy:
.1 Telecommunications rooms (TRs) and equipment room (ER and/or MC) termination detail sheets.
.2 Cross-connect schedules including entrance point, main cross-connects, intermediate cross-connects, and horizontal cross-connects.
.3 Labelling and administration documentation.
.3 Submit project cable plant infrastructure test records at conclusion of the project and include in both soft and hard copy:
.1 Copper certification test result in format acceptable to the Client Technical Authority.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Hubbell
.2 Leviton
.3 Panduit
.4 Or approved alternate

2.2 FABRICATION

.1 Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of equipment and its installation.

2.3 SUITABILITY

.1 Provide products that are suitable for intended use, including, but not limited to environmental,

regulatory, and electrical.

2.4 VOICE/DATA - COPPER WORK AREA JACKS

.1 Single-gang mounting faceplate or modular furniture faceplate with four (4) openings containing the following devices:
.2 White in colour
.3 Voice Jack - 8-pin modular, category 6, unkeyed, grey, pinned to T568 (A) standards.
.4 Data Jack - 8-pin modular, category 6, unkeyed, blue, pinned to T568 (A) standards.

2.5 WALL VOICE OUTLETS

.1 Single-gang stainless steel faceplate with RJ45 jack and wall telephone mounting lugs.

2.6 TELECOMMUNICATIONS ROOM COPPER PATCH CORDS

.1 All patch cords used to provide an interface between the active equipment and the Patch Panel. They shall be Category 6 Modular Cords, blue, RJ45/RJ45, 7 feet in length.
.2 Patch cords to be made up on site from same spool of cable.

2.7 WORK AREA COPPER PATCH CORDS

.1 All patch cords used to provide data service. They shall be Category 6 Modular Cords, blue, RJ45/RJ45, half of project 7ft., half of project 15ft. in length.
.2 Provide the following quantities - 1 per voice outlet, 1 per data outlet.
.3 Patch cords to be factory made units complete with test results.

2.8 EQUIPMENT RACKS

.1 Open frame, 19 in. equipment racks, 84 inches. Overall height with flange base, mounting rails drilled front and back provided standards (qty 3 racks).
.2 Provide accessories such as Vertical and Horizontal Cable Managers, 2 power bars, shelves, etc. One cable manager per 48 port patch
.3 All products supplied to be approved by the Client Technical Authority.
.4 Racks to be Star Tech manufacturer with cage-net style mounts on 19" centers.

2.9 NETWORK SWITCHES

.1 Supplied and installed by Owner. Coordinate all locations in racks.

2.10 POTS VOICE DROPS

.1 Plain old telephone system voice drops (fax, security system, elevator, fire alarm) shall be category 3 wired with RJ11 jacks and shall run back to BIX field at main telephone system cross connect. Cross connect by Division 16.

3 EXECUTION

3.1 GROUNDING

.1 Grounding shall conform to ANSI/TIA/EIA 607(A) - Commercial Building Grounding and Bonding Requirements for Telecommunications, Canadian Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum.
.2 Bond and ground equipment racks, housings, messenger cables, and raceways.
.3 Connect cabinets, racks, and frames to single-point ground which is connected to building ground system via #6 AWG green insulated copper grounding conductor.

3.2 LABELLING

.1 Labelling shall conform to ANSI/TIA/EIA-606(A) standards. The labelling scheme shall be as per the Client Technical Authority. In addition, provide the following:
.2 Label each outlet with permanent self-adhesive label with minimum 3/16 in. high characters.
.3 Use labels on Identification Strips on IDC field. Provide facility assignment records in a protective cover at each telecommunications closet location that is specific to the facilities terminated therein.
.4 Use colour-coded labels for each termination field that conforms to ANSI/TIA/EIA-606(A) standard colour codes for termination blocks.
.5 Mount termination blocks on colour-coded backboards.
.6 Labels shall be machine-printed. Hand-lettered labels shall not be acceptable.
.7 Label cables, outlets, and punch blocks with TR designation number followed by sequential numbering to match IDC field termination location. The recommended numbering scheme is (floor, TR number, IDC field number), for example 2.2.100 (floor 2, TR 2, IDC port number 100).
.8 Mark up floor plans showing outlet locations, type, and cable marking of cables. Turn these drawings over to the owner two (2) weeks prior to move in to allow the owner's personnel to connect and test owner-provided equipment in a timely fashion.

3.3 TESTING

.1 Testing shall conform to ANSI/TIA/EIA-568-B.1 standard. Testing shall be accomplished using level III or higher field testers.
.2 Test each pair and shield of each cable for opens, shorts, grounds, and pair reversal. Correct grounded and reversed pairs. Examine open and shorted pairs to determine if problem is caused by improper termination. If termination is proper, tag bad pairs at both ends and note on termination sheets.
.3 Perform testing of copper cables with tester meeting ANSI/TIA/EIA-568-B.1 requirements.
.4 If copper backbone cable contains more than one (1) percent bad pairs, remove and replace entire cable.
.5 If horizontal cable contains bad conductors or shield, remove and replace cable.
.6 Testing procedures shall utilize "Method B" - One jumper reference.
.7 Where any portion of system does not meet the specifications, correct deviation and repeat applicable testing at no additional cost to the owner.
.8 Provide written report of all testing to the Consultant and to the Commissioning Agent for review.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for the fire alarm system. Ensure that the shop drawings and product data sheets indicate all features of the system and its components to confirm that the system is in accordance with requirements of this Section. Include the following:
- .1 Identified wiring schematics with component identification and product/catalogue numbers for the central control facility and all associated components
- .2 A complete, zoned block riser diagram identifying all components and circuits
- .3 A complete sequence of operation cross-referenced to the riser diagram
- .4 Complete information and drawings describing and depicting the entire system(s) as installed, including all information necessary for maintaining, troubleshooting, and/or expanding the system(s) at a future date.
- .5 Complete documentation of system(s) testing.
- .6 Certification that the entire system(s) has/have been inspected and tested, is/are installed entirely in accordance with the applicable codes, standards, manufacturer's recommendations and ULC listings, and is/are in proper working order.

.2 Submittals to Fire Authority: Submit to the local fire authority at the same time as submittal to the Consultant, all items required by subparagraphs of paragraph .1 above.

.3 System Review and Confirmation: As specified in Part 3 of this Section, submit a letter from the system manufacturer/supplier which confirms that the system has been properly installed in accordance with issued installation instructions, and an inspection and test report in accordance with CAN/ULC-S536.

.4 Operation and Maintenance Training: Include for a minimum of two on-site training sessions for the Owner's personnel. Each session is to be a minimum of four hours in duration for up to six people per session, and is to be conducted by qualified personnel using operation and maintenance manual data as the basis for the instruction. Additionally the instruction shall cover the schedule of maintenance required by ULC and any additional maintenance recommended by the system manufacturer. Instruction shall be made available to the Local Municipal Fire Department if requested by the Local authority having Jurisdiction.

.5 Operation and Maintenance Training DVD: When on-site maintenance and training is complete, supply and hand to the Owner a DVD outlining complete operation and maintenance procedures.

.6 Panel/Enclosure Keys: Submit a minimum of three identified keys for any panel or enclosure with a keyed lock door.

.7 Spare Parts: Prior to Substantial Performance of the work, supply, in identified original packaging and hand to the Owner at the site where directed, unless otherwise indicated, the following spare parts:
- .1 Pull stations, 10% of the number installed, minimum three, and, if pull stations use glass rods, twenty glass rods
- .2 Smoke detectors, 10% of the number installed for each type, minimum two
- .3 Thermal detectors, 5% of the number installed for each type, minimum one
- .4 Indicating lamps, five for each type and colour used
- .5 Provide 5 extra bells and 5 extra strobes for installation after sound tests are conducted
- .6 Fuses, three for each type used

.8 Manufacturer's Support of System Components: Submit, on the system manufacturer's letterhead and signed by a signing officer of the company, a written declaration that manufacturer will supply system replacement parts for a minimum of ten years from Substantial Performance of the work.

.9 As-Built Record Drawing Requirements: In addition to all other "as-built" conditions, indicate on as-built record drawings the locations of all end-of-line resistors and all line isolation modules.

.10 Independent Third Party Testing and Verification Agency: Submit the name, qualifications, and certification of the independent third party testing and verification agency proposed for the project.

.11 Certificate of Insurance: As specified in Part 3, submit a Certificate of Insurance covering testing and verification of the fire alarm system.

.12 Extended Warranty: Submit a signed extended warranty in the name of the Owner covering the entire fire alarm system for a period of two years after the Contract warranty expires. The terms of the

extended warranty are to be full parts and on-site labour as for the Contract warranty.

1.2 QUALITY ASSURANCE

.1 The fire alarm system and its installation is, as applicable, to be in accordance with requirements of the following:
- .1 CSA B222, Installation Code for Local Fire Alarm Systems
- .2 CSA C22.2 No. 208, Fire Alarm and Signal Cable
- .3 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems
- .4 CAN/ULC-S525, Audible Signal Devices for Fire Alarm Systems, Including Accessories
- .5 CAN/ULC-S526, Visual Signal Devices for Fire Alarm Systems, Including Accessories
- .6 CAN/ULC-S527, Control Units for Fire Alarm Systems
- .7 CAN/ULC-S528, Manual Pull Stations for Fire Alarm Systems, Including Accessories
- .8 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems
- .9 CAN/ULC-S530, Heat Detectors
- .10 CAN/ULC-S531, Smoke Alarms
- .11 CAN/ULC-S533, Egress Door Securing and Release Devices
- .12 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems
- .13 CAN/ULC S537, Standard for the Verification of Fire Alarm Systems
- .14 CAN/ULC-S552, Maintenance and Testing of Smoke Alarms
- .15 CAN/ULC-S553, Installation of Smoke Alarms
- .16 CAN/ULC-S559, Equipment for Fire Signal Receiving Centres and Systems
- .17 CAN/ULC-S561, Installation and Services for Fire Signal Receiving Centres and Systems
- .18 ULC/ORD 693, Central Station Fire Protective Signalling
- .19 ULC-S548, Alarm Initiating and Supervisory Devices for Water Type Extinguishing Systems
- .20 National, Provincial and Local Building Codes
- .21 Ontario Electrical Safety Code

.2 System Components: All system components are to be ULC listed and labelled in accordance with standards listed above, and, unless otherwise specified, are to be supplied by a single manufacturer. All components must be suitable in all respects for conditions of the installation location. Any equipment not bearing a ULC label shall be removed and replaced with compatible ULC labelled equipment at the Contractors expense.

.3 System Software: System software is to be open protocol and fully custom programmed with the system sequence of operation.

.4 Qualifications of Manufacturer: Equipment and materials shall be provided by an experienced reputable manufacturer to ensure proper specification adherence, final connection, test, turnover, warranty compliance, and service. The manufacturer is required to have been in the fire alarm industry (service and installation) for a minimum of ten (10) years. The manufacturer shall have in-house engineering and project management capability consistent with the requirements of this project. Qualified and approved representatives of the system manufacturer shall perform the detailed engineering design of central and remote control equipment.

1.3 WARRANTY PERIOD REQUIREMENTS

.1 The system manufacturer/supplier must have a local repair and maintenance facility and must respond to any system operational problem during the warranty period (including the extended warranty) within four hours of notification by the Owner, twenty-four hours a day, seven days a week.

.2 The system manufacturer/supplier is to maintain accurate record of each warranty call to the site and document the date and time of the call, the reason for the call, and the duration and type of the corrective action taken.

.3 During the warranty period, any spare parts in the Owner’s possession are to be replaced if used for corrective actions.

1.4 SOFTWARE REVISIONS

.1 After successful testing, verification and commissioning of the system, but prior to turn over to the Owner, obtain a list of final room, area, and , if applicable, building names and revise system software to incorporate all required revisions.

.2 Include for an additional software update to suit any requirements of governing authorities.
.3 In addition to programming revisions specified above, include for, after system turn over to the Owner, another site visit to make any supplementary software revisions requested by the Owner.

1.5 LEED CERTIFICATION

.1 When work is complete, arrange for the system manufacturer/supplier to submit the required completed LEED documentation indicating the percentage of recycled material used in manufacture of system components, and that the system adheres to LEED requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with requirements specified in the Section entitled Basic Electrical Materials and Requirements.

1.7 ACCEPTABLE MANUFACTURERS

.1 Edwards cat #QS4 fire alarm system or equal by:
  .1 Honeywell Notifier
  .2 Simplex Grinnell (Tyco International of Canada Ltd)
  .3 Siemens Building Technologies]
  .4 Gardia Industries Inc. – Mircon]
  .5 Or approved equivalent

1.8 GENERAL

.1 Provide all labour, services and materials necessary to provide and install a complete, functional life safety fire system. The System shall comply in respects with all pertinent codes, rules, regulations and laws of the local Authority Having Jurisdiction. The System shall comply in all respects with the requirements of these specifications, manufacturer's recommendations and Underwriters' Laboratories of Canada (ULC) listings.
.2 This Fire Alarm / Life Safety System Specification must be conformed to, in its entirety to ensure that the installed and programmed Life Safety System will function as designed, and will accommodate the future requirements and operations required by the building owner. All specified operational features must be met without exception.
.3 Upon completion of this work, provide the Owner with: Complete information and drawings describing and depicting the entire system(s) as installed, including all information necessary for maintaining, troubleshooting, and/or expanding the system at a future date.
.4 The system shall include, but not be limited to:
  .1 Fire alarm control panel and remote annunciator(s).
  .2 Automatic and manually activated alarm initiating and monitoring devices
  .3 Audible and Visual Notification appliances and peripherals
  .4 Standby power supplies
  .5 System programming and commissioning.
  .6 Training of operators
  .7 Conduit, wire, and accessories required to provide a complete and operational life safety system

1.9 DEFINITIONS / ABBREVIATIONS

.1 AFF: Above Finished Floor.
.2 AHJ: Authority Having Jurisdiction.
.3 Approved: Unless otherwise stated, materials, equipment or submittals approved by the Authority or AHJ.
.4 Circuit: Wire path from a group of devices or appliances to a control panel or transponder.
.5 Class A Circuit: (Return Loop Circuit) – A circuit having one continuous path connecting all components on the circuit and terminating through an alternate connection path in the source enclosure.

.6 Class B Circuit: (Terminated Circuit) – A circuit having one continuous path connecting all devices on the circuit and terminating at an end-of-line device.
.7 CPU: The central computer of a multiplex fire alarm or voice command control system.
.8 Data communications Link (DCL): the data channel between the control units, annunciators, active field devices and supporting field devices of a distributed type system.
.9 FACP: Fire Alarm Control Panel.
.10 HVAC: Heating Ventilating and Air Conditioning.
.11 IDC: Initiating Device Circuit.
.12 LED: Light Emitting Diode.
.13 LCD: Liquid Crystal Display.
.14 NAC: Notification Appliance (Signal) Circuit.
.15 ULC: Underwriters Laboratories of Canada
.16 ULC Listed: Materials or equipment listed and included in the most recent edition of the ULC Fire Protection Equipment Directory.
.17 Zone: Combination of one or more circuits or devices in a defined building area, i.e. 3 circuits on a floor combined to form a single zone.

1.10 SYSTEM DESCRIPTION

.1 Design requirements
  .1 All control panel assemblies and the connected automatic and manual alarm and notification appliances shall be designed and manufactured by the same company; shall be tested and cross-listed as to ensure that a fully functioning life safety system is designed and provided.
  .2 The Fire Alarm / Life Safety System supplied under this specification shall be a microprocessor-based, Conventional Fire Alarm / Life Safety system.
.2 The control panel shall use a multiple microprocessor design so that the failure of a single microprocessor will not result in a total system failure. Fire alarm systems that utilize only one microprocessor for system and Data Communications Link (DCL) control will not be accepted.
.3 All Fire Alarm equipment shall be arranged and programmed to provide a system for the early detection of fire, the notification of building occupants, the automatic summoning of the local fire department, the override of the HVAC system operation, and the activation of other auxiliary systems to inhibit the spread of smoke and fire, and to facilitate the safe evacuation of building occupants.
.4 A standby power supply shall automatically provide electrical energy to the system upon primary power supply failure. Standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for 24 hours and capable of operating the system for 30 minutes in the alarm mode at 100% load. Fire alarm system shall include a charging circuit to automatically maintain the electrical charge of the battery.
.5 Performance
  .1 The Alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler waterflow, shall cause the following functions to automatically occur:
    .1 The internal audible device shall sound at the control panel and/or remote annunciator(s).
    .2 The LCD Display shall indicate all applicable information associated with the alarm condition including; zone, device type, device location and time/date.
    .3 All system activity/events shall be documented in system history and on the system printer. The system shall store a minimum of 1000 events in history.
    .4 Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
    .5 Activate audible notification appliances throughout the building as programmed.
    .6 Activate visual strobe notification appliances throughout the building. The visual strobe shall continue to flash until the system has been reset. The visual strobe shall not stop operating when the "Alarm Silence" is pressed.
    .7 Transmit signal to the Central Station with point identification.
    .8 All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
    .9 All stairwell/exit doors shall unlock throughout the building.
    .10 All self-closing fire/smoke doors held open shall be released.

.2 The Supervisory activation of any sprinkler valve supervisory switch shall cause the following functions to automatically occur:
- .1 The internal audible device shall sound at the control panel and remote annunciator(s).
- .2 The LCD Display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.
- .3 All system activity/events shall be documented on the system printer and system history file.
- .4 Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
- .5 All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
- .6 Transmit signal to the Central Station with point identification.

.3 The trouble activation of any internal or field device or wiring fault shall cause the following functions to occur:
- .1 The internal audible device shall sound at the control panel and/or remote annunciator.
- .2 The LCD Display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
- .3 All system activity/events shall be documented on the system printer and system history file.
- .4 Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
- .5 Transmit trouble signal to the Central Station.

.4 The Status activation (monitor) of any fire pump or generator shall cause the following functions to automatically occur:
- .1 The internal audible device shall sound at the control panel and/or remote annunciator.
- .2 The LCD Display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.
- .3 All system activity/events shall be documented on the system printer and system history file.
- .4 Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated

1.11 EXISTING SYSTEMS

.1 Before construction begins on any phase as outlined in architectural contract documents, the fire alarm system verification and certification contractor shall verify the existing fire alarm system and insert on Autocad CD floor plans supplied by the Consultant, the address and location of each existing intelligent/addressable initiating and signal device and each existing intelligent/addressable module for existing non-addressable fire alarm zones and each non-intelligent/addressable initiating and signal device. The Autocad version shall match that of the contract drawings. Submit a copy of the record CD to the Contractor and to the Consultant. Include a verification statement as per CAN/ULC-S537.

.2 At the beginning of each construction phase, existing initiating devices, in the area of construction, shall be disconnected and removed. Provide in area of construction, during the construction period, temporary life safety devices and/or fire watch personnel as required by applicable codes.

.3 At the completion of construction, at completion of each phase of construction, and after attaining Substantial Performance, and after verification and certification of the total system as per Section 27 09 65, the verification and certification contractor shall insert on Autocad CD floor plans supplied by the Consultant, the address of [each intelligent/addressable initiating and signal device and] [each intelligent/addressable module for non-addressable fire alarm zones and] each non-addressable initiating and signal device. The Autocad version shall match that of the contract drawings. Submit a copy of the record CD to the Contractor and to the Consultant. Include a verification statement as per CAN/ULC-S537.

2 PRODUCTS

2.1 MANUFACTURER

.1 The manufacturer of the system equipment shall be regularly involved in the design, manufacture, and distribution of all products specified in this document. These processes shall be monitored under a quality assurance program that meets the ISO 9001:2008 requirements.
All System components shall be the catalogued products of a single supplier. All products shall be listed by the manufacturer for their intended purpose.
Chubb Edwards products constitute the minimum type and quality of equipment to be installed.
All control panel assemblies and connected field appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as to ensure that a fully functioning is designed and installed. The system supplied under this specification shall be a microprocessor-based, direct wired, multi-priority peer-to-peer networked system. The system shall utilize electronically addressed, microprocessor-based smoke detectors, heat detectors, and modules as described in this specification.

2.2 PANEL COMPONENTS AND FUNCTIONS

.1 General
- .1 The control panel shall be a multi-microprocessor based system designed specifically for fire and releasing system applications. The control panel shall be listed and approved for the application standard(s) as listed under the General section.
- .2 The control panel shall include all required hardware, software and system programming to provide a complete and operational system. The control panel shall assure that life safety takes precedence among all panel activities.
- .3 The control panel shall include the following capacities:
  - .1 Support 1 up to 1000 analog/addressable points and 48 conventional circuits.
  - .2 Support programmable relays in the control panel
  - .3 Support up to 8 fully supervised remote LED/LCD annunciators.
  - .4 Support an internal, panel mount digital dialer (DACT) with multiple communication protocols that is powered from the control panels regular and standby power supplies.
  - .5 Support up to 1000 chronological history events.
- .4 The control panel shall include the following features:
  - .1 Provide electronic addressing of analog/addressable devices.
  - .2 Be capable of full system programming through the front panel.
  - .3 Be capable of uploading the system program from the CPU to a laptop.
  - .4 Provide an operator interface display that shall include functions required to annunciate, command and control system functions.
  - .5 Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
  - .6 Provide discreet system control switches for reset, alarm silence, panel silence, drill, scroll up/down/right/left, system status and help.
  - .7 Provide comprehensive system reports including dirty detector and sensitivity reports
  - .8 Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
  - .9 Provide an authorized operator to perform test functions within the installed system.
  - .10 All system programming and history shall be permanently stored in non-volatile memory to ensure that no programming or history is lost. Systems which store initial programming or field programming changes in battery backed memory will not be accepted.
- .5 Supervision of system components, wiring, devices and software shall be provided by the control panel. System component fault or wiring fault shall be indicated by type and location on the LCD display.
- .6 Software and processor operation shall be independently monitored for failure. The system shall provide a CPU fail-safe operation. In the event the main CPU fails, the system shall still process an alarm event using a general alarm type operation.
- .7 The system shall be capable of comparing the current version programming to a previous

version using a compare utility. The utility shall generate a difference report indicating what changes have been made in hardware and software correlations.

.2 Operators' Interface:

.1 A Liquid Crystal Display (LCD) shall provide the means to inform the system operator with detailed information about the off-normal status of the installed Fire Alarm / Life Safety System. The LCD shall automatically respond to the status of the system, and shall display that status in a 224-character front panel display.

.2 The following status functions shall be annunciated by the LCD Display:

.1 When the Fire Alarm / Life Safety System is in the "Normal" Mode, the panel shall display: current date and time, a two-line custom system title, and a summary of the systems alarm history.

.2 With the Fire Alarm / Life Safety System is in the off-normal mode, the LCD display shall automatically reconfigure into three logical areas.

.3 Panel Status Area - The LCD shall show the system time, the number of active points, and disabled points in the system.

.4 Event Area - The LCD shall show the first two active events of the highest priority

.5 Type Status Area - The LCD shall show the total number of active events in the system, summarized by the following event types: "Alarm Events", "Supervisory Events", "Active Trouble Events", and "Active Monitor Events".

.3 Addressable Device Data Communications Link (DCL):

.1 A 100% digital loop controller shall be provided in the Fire Alarm / Life Safety System panel to interface with the intelligent microprocessor-based detectors and modules.

.2 It shall be possible to connect the loop controller to the detectors and modules using any wiring material or method complying with Section 32 of the Ontario Electrical Safety Code without the need for special shielded or twisted wire. The loop controller shall be capable of supporting Class A (Style 7) or Class B (Style 4) circuits without the need for additional hardware modules. It shall be possible to T-Tap multiple branch circuits from the DCL.

.3 The loop controller shall be capable of automatically addressing all intelligent microprocessor-based devices connected to it electronically, without the need to set switches at any of the individual device locations.

.4 The loop controller shall provide a minimum of 6 types of supervision for each intelligent device on the circuit:

.1 Device location

.2 Unexpected device add/Delete

.3 Missing device address

.4 Changes in the physical wiring of the circuit

.5 Changes in device settings

.6 Device maintenance alert

.5 The loop controller shall determine the electrical location of each connected detector and module. The location and type of each connected device shall be mapped and stored in memory in the loop controller. It shall be possible to access and display this map.

.6 It shall be possible to obtain a mapping report of all devices connected to the loop controller for confirmation of "as-built" wiring. The mapping report shall show the electrical relationship of all connected devices, including T-Taps, device types, and the address of each device on the circuit. The loop controller shall be capable of reporting any additional device addresses, which may have been added to the circuit, and/or changes that may have been made to the wiring. A specific trouble shall latch on the system until the changes are verified and accepted in the program by authorized personnel.

.7 The loop controller shall notify the system when any connected smoke detector reports a "routine maintenance required" signal to the system.

.4 Notification Appliance Circuits:

.1 Provide as indicated on the plans, supervised hard-wired Notification Appliance (Signal) Circuits (NAC) for the control of 24Vdc notification appliances. Each NAC shall operate as Class B (Style Y) power limited circuit.

.2 NAC's shall be capable of providing steady, 20bps, 120bps or temporal rate outputs.

.5 Power Supply

.1 Each system power supply shall be a minimum of 6 amps @ 24 Vdc.

.2 Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any alarm, trouble or operator acknowledgment signals.

.3 Each system power supply shall be annunciated individually as a trouble signal, identifying the inoperable power supply(ies).

.4 All standby batteries shall be continuously monitored by the system. Low battery and disconnection of battery power supply conditions shall immediately annunciate as a trouble signal, identifying the deficient batteries.

.6 Dialer (Digital Alarm Communicator Transmitter – DACT)

.1 The system shall provide an off premise communications module capable of transmitting system events to multiple primary and secondary central monitoring station receivers.

.2 The system shall be capable of transmitting point information via Contact ID or SIA 4/2 protocols up to 8 subscribers.

.7 System Reports

.1 The system shall provide the operator with reports that:

.1 Give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD, [and shall be capable of being printed on the system printer].

.2 Lists all the detectors connected to the system that are in need of cleaning.

.3 Lists the sensitivity in "% smoke obscuration per foot" of all analog/addressable detectors connected to the system.

.4 Gives a chronological listing of the last 1000 system events.

.5 Lists the firmware revisions for all of the installed components in the system.

2.3 LIFE SAFETY SYSTEM PROGRAMMABLE OPERATIONS

.1 The routing of all system annunciation and control parameters shall be configurable to any or all remote annunciators on the system manually, or automatically as a function of the time of day or date.

.2 Each remote annunciator connected to the panel shall be configurable to show the status of any combination or of Alarm, Supervisory, Trouble, Monitor functions pertaining to any point in the system.

.3 The system printer shall be configurable to print all or any combination of the following functions: Alarm, Supervisory, Trouble, and Monitor events.

.4 Each device address in the system may be customized with up to a 32 character message.

.5 The system shall support software defined Logical Zone Groups which may group any input from any initiating device circuit, in order to control a system output or function, or initiate any system operational sequence. A device or initiating device circuit may be a member of one Zone.

.6 The system shall have the capability to provide logical "Counting AND" Groups and "Matrix Groups". Each matrix group shall be programmable by device radius and activation number.

.7 The system shall have the ability to define Service Groups. A Service group shall consist of any addressable field device and shall not be defined or limited by the physical layout of the Fire Alarm / Life Safety System, or its application to the protected premises. The system shall include the ability to define an alternate set of device commands which may be used in combination with the system test command and service groups for the testing of the connected addressable devices.

.8 The system shall include Time Control functions that have the ability to control any system output or system operational sequence as a function of the month, day of week, date, hour, minute, or holiday.

.9 The system shall have the ability to upload data from the intelligent devices and CPU programmed correlations to a PC while the system is on-line and operational in the protected premises. The uploaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.

2.4 FIELD MOUNTED SYSTEM COMPONENTS

.1 Analytical Microprocessor-based Addressable Detectors - General:

.1 Early warning analog addressable detectors shall use state-of-the-art multi-sensor or technology. Each detector shall incorporate a microprocessor capable of making alarm decisions based on fire parameter algorithms stored in the detectors head. The microprocessor shall evaluate all sensing elements simultaneously and take into account real-time environmental conditions and the duration of an event, resulting in reliable and accurate

decisions that distinguish real fire conditions from unwanted deceptive nuisance alarms. Digital filters shall eliminate signal patterns that are not typical of fires. Detectors that use the control panel processor to make alarm decisions are not acceptable.

.2 Addressable detectors shall be capable of full digital communications using both broadcast and polling protocols. The maximum total analog loop response time for detectors shall be 750 ms. The maximum alarm response time for the system to sound an alarm shall not be more than 3-seconds regardless of the detector location or the number of detectors on the addressable loop. The analog loop controller shall support up to 250 devices including 125 modules, 125 detectors and 125 isolator bases. The analog loop must not require shielded wire and shall be capable of a total distance of 1219 m (4000 feet) minimum using #18AWG twisted pair when 100 addressable detectors and 100 addressable modules are connected. The analog loop shall support up to 124 wiring T-taps.

.3 The analog loop controller shall be able to “map” and supervise the location of each addressable device installed on the loop. Device supervision shall be provided for any device that is missing, added or changes to the device type, alarm settings, features, location or changes to the wiring layout or detector bases. It shall be possible to display or print the device “map” from a laptop. The “map” shall indicate all devices on the addressable loop complete with the customer defined device location name, device and base type, supervision information and wiring as-built layout including all T-taps. If two devices are inadvertently switched during routine maintenance, the loop controller shall be able to identify the change and if the device types are identical, it shall automatically download environmental information specific to that device location and all programming shall remain intact for the respective location of each device. No reprogramming or manual addressing shall be required. If the device types do not match, both devices shall still provide their inherent protection, programmed functions shall respond accordingly for that device location and a trouble shall be logged on the system. The “map” shall indicate which devices have been switched, what device type was expected and what device type is actually installed in that location.

.4 Each detector shall have the ability to learn its environment and automatically adjust its reference value for changes in its environment. Detectors that require adjustments to their sensitivity settings months after they are installed are not acceptable. Environmental compensation shall allow each sensing element to adapt to short and long term changes caused by dirt, dust, humidity, temperature and ageing. The detector shall adjust and update its sensitivity (% obscuration) and ambient temperature baselines for each sensing element approximately six times per hour. The detector shall utilise a 4-hour rolling average of the environmental information and for verification purposes also maintain a 24-hour average of the analog values, both of which may be taken into account in the alarm decision making process.

.5 The detectors on-board micro-processor shall monitor the environmental effects on its baseline and generate a “maintenance alert” message at the control panel when the detectors environmental compensation is 80% used up indicating it should be cleaned. This event shall be programmable to initiate any type of system response such as send a pocket pager message to maintenance. When the environmental compensation head room is 100% used up, a trouble condition shall latch on the system to advise that the detector requires cleaning immediately. Up to this point the detectors sensitivity shall not have been compromised. Dirty detectors that continue to be ignored will eventually post an internal device fault and will not false alarm as a result of the accumulation of dirt. Dirty detectors that false alarm if not cleaned are not acceptable.

.6 The detector shall be capable of identifying up to 32 self-diagnostic codes including verification that the detectors reference value is within its prescribed factory and ULC limits. Sensitivity reports shall include the percent obscuration that the detectors alarm level is set at and the percentage of compensation used as a result of environmental factors (dirt, dust, humidity, etc). This information shall be available for system maintenance and may be requested per device or generate reports based on only the detectors that require cleaning.

.7 The early warning analog addressable detectors and the analog loop controller shall provide increased reliability and inherent survivability through intelligent analog conventional operation. Detectors shall automatically change to stand alone, conventional device operation in the event of a loop controller polling communications failure. In the analog conventional

detector mode, each detector shall continue to operate using its programmed sensitivity and "learned" environmental information stored in the detector's memory at the time of communication failure. The analog loop controller shall be capable of monitoring the loop and activating a loop alarm, without communicating to the devices, if any detector reaches its alarm sensitivity threshold.

.8 Each Signature Series device shall be capable of automatic electronic addressing and/or custom addressing without the use of DIP or rotary switches. Devices using DIP or rotary switches for addressing, either in the base or on the detector shall not be acceptable.

.9 Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm normal status communication with the analog loop controller. A red LED shall flash to display alarm status. Both LED's on steady shall indicate an alarm in the conventional stand-alone mode status. The LEDs shall be visible through a full 360 degree viewing angle.

.10 It shall be possible to matrix program Signature analog detectors. Responses shall be programmable based on activated detectors within the physical location to one another and/or the number of activated detectors in a programmable group or groups.

.11 All detectors shall be compatible with all Signature Series mounting bases.

.2 Detectors – 4D Multi-Sensor Detectors (Ion, Photoelectric, Thermal & Time)

.1 Provide intelligent Signature Series 4D multi-sensor smoke detectors in order to provide the fastest detection to the broadest range of fire types without having to pre-determine the environment contents or possible types of smoke and fire. Detectors that must have their environment type predefined are not acceptable since environment contents are continually changing. The multi-sensor analog detector shall gather analog information from each of its three sensors: a light scattering type photoelectric sensor for visible smoke, a unipolar ionization sensor for invisible particles of combustion and an ambient temperature sensor for monitoring the amount of heat. The integral microprocessor shall employ time-based algorithms to dynamically examine values from the three sensors simultaneously and make an alarm decision based on that data. Separately mounted photoelectric detectors, ionization detectors and heat detectors in the same location are not acceptable alternatives. Detectors that do not operate in unison are not acceptable.

.2 Each detector shall be capable of adapting to ambient environmental conditions. The temperature sensor shall self-adjust to the ambient temperature of its environment. In addition to contributing to the algorithm based alarm decision, the integral heat sensor shall cause an alarm when it senses a change in ambient temperature of 35ºC (65ºF) or reaches it fixed temperature alarm set point of 57ºC (135ºF) nominal. Only detectors with heat elements that operate independently and contribute to the smoke alarm algorithm decision are acceptable.

.3 The detector shall have a ULC Smoke Sensitivity Range of 0.67-3.7% obscuration/305mm (foot). The alarm smoke obscuration per foot setting shall be field selectable to any one of five sensitivity settings ranging from 1.0% to 3.5%. The pre-alarm smoke obscuration per 305 mm (foot) setting shall be field selectable in .05% increments for a total of 10 selections per sensitivity setting starting at 0.5% smoke obscuration per foot. Multi-sensor analog detectors shall be capable of an automatic day/night alternate sensitivity adjustment for both alarm and pre-alarm thresholds. Alarm and pre-alarm events shall have independent programmable responses. The pre-alarm message shall display in the monitor queue and the alarm message in the alarm queue.

.4 The multi-sensor detectors shall be rated for ceiling or wall mount applications and for direct insertion into air ducts up to 0.91m (3 ft) high and 0.91m (3 ft) wide and low air velocities up to 2.54 m/sec (500 ft/min.) without requiring specific duct detector housings or supply tubes. The multi-sensor detector shall be rated for ceiling installation with maximum 9.1m (30-foot) centers. For clean room applications requiring very early warning pre-alarm sensitivities, recommended area coverage is 18.6 m2 (200ft2)

.5 The detector shall be protected by a ULC listed protective guard in areas where subjected to mechanical damage or abuse. The design must be 100% compatible with the detector and must not affect the detector sensitivity or reduce detector spacing. The guard shall be low profile and suitable for flush or surface mounted detectors.

.6 The multi-sensor detector shall be suitable for operation in the following environment:

.1 Temperature: 0ºC to 38ºC (32ºF to 100ºF)
.2 Humidity: 0-93% RH, non-condensing
.3 Elevation: Up to 1828 m (6,000 ft)

.3 Detectors – 3D Multi-Sensor Detectors (Photoelectric, Thermal & Time)

.1 Provide intelligent Signature Series 3D multi-sensor smoke detectors. The multi-sensor analog detector shall gather analog information from each of its two sensors: a light scattering type photoelectric sensor and an ambient temperature sensor. The integral microprocessor shall employ time-based algorithms to dynamically examine values from each sensor simultaneously and make an alarm decision based on that data. Separately mounted photoelectric and heat detectors in the same location are not acceptable alternatives.

.2 Each detector shall be capable of adapting to ambient environmental conditions and the integral heat sensor shall be capable of causing an alarm when it reaches its fixed temperature alarm set point of 57ºC (135ºF) nominal.

.3 The detector shall have a ULC Smoke Sensitivity Range of 0.67-3.7% obscuration/ft 305mm (foot). The alarm smoke obscuration per foot setting shall be field selectable to any one of five sensitivity settings ranging from 1.0% to 3.5%. The pre-alarm smoke obscuration per foot setting shall be field selectable in .05% increments for a total of 19 selections per sensitivity setting starting at 0.05% smoke obscuration per foot. Multi-sensor analog detectors shall be capable of an automatic day/night alternate sensitivity adjustment for both alarm and pre-alarm thresholds. Alarm and pre-alarm events shall have independent programmable responses. The pre-alarm message shall display in the monitor queue and the alarm message in the alarm queue.

.4 The multi-sensor detectors shall be suitable for area protection and for direct insertion into air ducts up to 0.91m (3 ft) high and 0.91m (3 ft) wide and air velocities up to 25.4 m/sec (5000 ft/min.) without requiring specific duct detector housings or supply tubes. The multi-sensor detector shall be rated for ceiling installation with maximum 9.1m (30-foot) centers. For clean room applications requiring very early warning pre-alarm sensitivities, recommended area coverage is 18.6m2 (200 square feet).

.5 The detector shall be protected by a ULC listed protective guard in areas where subjected to mechanical damage or abuse. The design must be 100% compatible with the detector and must not affect the detector sensitivity or reduce detector spacing. The guard shall be low profile and suitable for flush or surface mounted detectors.

.6 The multi-sensor detector shall be suitable for operation in the following environment:

.1 Temperature: 0ºC to 38ºC (32ºF to 100ºF)
.2 Humidity: 0-93% RH, non-condensing
.3 Elevation: no limit

.4 Detectors - Photoelectric Smoke Detector, (Duct Detector Use)

.1 Photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to detect visible particulates produced by combustion. The integral microprocessor shall dynamically examine values from the sensor and initiate a system alarm based on the analysis of data.

.2 The alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5% smoke obscuration per foot. The photo detector shall be suitable for operation in the following environment:

.1 Temperature: 0ºC to 49ºC (32ºF to 120ºF)
.2 Humidity: 0-93% RH, non-condensing
.3 Elevation: no limit

.5 Duct Detector Housing:

.1 The Analytical Microprocessor-based photoelectric smoke detector shall be readily adaptable for use in air duct smoke detection applications, using a housing that mounts to the outside of the duct. When used for duct smoke detection, the smoke detectors will not forfeit any of the system functionality that they have when used as area smoke detectors.

.2 The duct smoke detection housing shall allow the detector to sample and compensate for, variations in duct air velocity between 91 and 1219 m (300 and 4,000 feet) per minute.

.3 Remote alarm LEDs and Remote Test Stations shall be supported by the duct smoke detector and provided where indicated.

.6 Detectors – Combination Fixed Temperature/Rate of Rise Heat Detector

.1 Heat Detector shall have a solid state heat sensor, and shall transmit an alarm at a fixed

temperature of 57ºC (135ºF) or due to a temperature Rate of Rise of 9ºC/minute (15ºF/minute). The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.

.2 The heat detector shall be rated for ceiling installation at 21.3m (70 ft) centers and be suitable for wall mount applications.

.7 Detectors - Fixed Temperature Heat Detector,

.1 Heat detector shall have a solid-state heat sensor, and shall transmit an alarm at a fixed temperature of 57ºC (135ºF). Detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.

.2 Heat detector shall be rated for ceiling installation at 21.3m (70 ft) centers and be suitable for wall mount applications.

.8 Detectors - Mounting Bases

.1 Mounting bases shall support all microprocessor-based detector types detailed in this specification

.2 Removal of the respective detector shall not affect communications with other addressable devices.

.3 Field wiring connections shall be made to the room side of the base, so that wiring connections can be made or disconnected by the contractor without the need for remove the mounting base from the electrical box.

.4 Bases will have the option of external LED operation, Relay Base or Data Line Isolator Base.

.5 The relay base shall support all Addressable Detector types and have the following requirements:

.1 Form “C” contacts rated at 1 amp @ 30VDC and listed for “pilot duty”.

.2 The position of the contact shall be supervised

.3 Separate power shall not be required to the relay base.

.4 The relay shall automatically de-energize when a detector is removed

.5 The relay operation shall be exercised by the detector processor on power up.

.6 The relay shall be a bi-stable type and selectable for normally open or normally closed operation.

.7 For added survivability, relay operation shall be controlled by the detectors microprocessor. The relay shall be capable or operation in the conventional stand-alone mode in the event communication is lost with the loop controller. Relay bases not controlled by the detector’s microprocessor shall not be acceptable.

.6 The isolator base shall support all Addressable Detector types and have the following requirements:

.1 The isolator shall operate within a minimum of 23msec of a short circuit condition on the analog communication wiring.

.2 An analog addressable detector mounted with an isolator base shall only use 1 address on the loop. It shall be possible to provide one isolator for every detector to achieve the highest level of survivability possible. The analog loop controller shall support up to 250 devices including 125 modules and 125 detectors with 125 isolator bases.

.3 In a Class A configuration, the analog loop controller shall identify an isolated circuit condition and provide communications to all non-isolated analog devices.

.4 Isolators are required between all Floor Areas as defined in the NBC.

2.5 MICROPROCESSOR-BASED INTELLIGENT MODULES – GENERAL

.1 Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable modules for the monitoring and control of system Input and Output functions over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All modules shall display communications and alarm status via LED indicators.

.2 The function of each connected module shall be determined by the module type, and shall be defined in the system software through the application of a personality code.

.3 All addressing of the Microprocessor-based Addressable Modules shall be done electronically, and the electrical location of each module shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the modules will not be

dependent on their electrical location on the circuit.

.4 All field wiring to the Microprocessor-based Addressable Modules shall be supervised for opens and ground faults and shall be location identified to the module of incidence.

.5 Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Microprocessor-based Addressable Modules to assist in troubleshooting system faults.

.6 Each module shall be suitable for operation in the following environment:
- .1 Temperature: 0ºC to 49ºC (32ºF to 120ºF)
- .2 Humidity: 0-93% RH, non-condensing

.7 Single Input Module:
- .1 Microprocessor-based Addressable Modules shall be used to provide one (1) supervised Class B (style B) input circuit capable of latching operation for use with contact devices, non-damped Waterflow Switches, non-latching supervisory sprinkler switches.

.8 Dual Input Module:
- .1 Microprocessor-based Addressable Modules shall be used to provide two (2) independent supervised Class B (style B) input circuits capable of operation with contact devices. Both of the input circuits shall be terminated to, and operated from, the same microprocessor-based addressable module.
- .2 Modules configured for Waterflow operation shall have an automatic delay of 15 seconds before reporting the Waterflow alarm condition to the Fire Alarm Control Panel. The module shall monitor sprinkler supervisory switches and shall automatically report the supervisory function to the Fire Alarm Control Panel each time the associated dry contact closes.

.9 Monitor Module:
- .1 The Microprocessor-based Addressable Monitor Module shall be factory set to support one (1) supervised Class B Normally-Open Active Non-Latching Monitor circuit. The module shall automatically report the monitor function to the Fire Alarm Control Panel each time the associated dry contact closes.

.10 Riser Select Signal Module:
- .1 The Microprocessor-based Addressable Riser Select Signal Modules shall be capable of selecting from one or two 24Vdc risers and connecting to one (1) supervised 2A Class B (style Y) Notification Appliance Output Circuit

.11 Control Relay Module:
- .1 Microprocessor-based Addressable Control Relay Modules shall provide the form “C” dry relay contact rated at 2 amps @ 24 Vdc or 0.5 amps at 120 VAC to, control external appliances or equipment processes. The control relay module shall be rated for pilot duty applications. The position of the relay contact shall be confirmed by the system firmware.

.12 Universal Class A/B Module,
- .1 The Microprocessor-based Addressable Module Universal Class A/B Module shall be capable of a minimum of fifteen (15) distinct operations. The universal class A/B module shall support one of the following circuit types:
  - .1 Supervised Class A/B Normally-Open Alarm (Active) (Delayed) (Non-) (Latching).
  - .2 Form “C” dry relay contact rated at 2 amps @ 24 Vdc.
  - .3 Supervised Class A/B 2-wire Smoke Alarm (Verified)
  - .4 Supervised Class A/B Signal Circuit, 24Vdc @ 2A.

.13 Universal Input/Output Module Support
- .1 Enclosure to provide mounting and wiring terminations for up to six addressable modules. The motherboard design shall provide two riser inputs that are common to all modules.

.14 Releasing Module
- .1 Provide intelligent analog addressable releasing modules where shown on the plans. The releasing module shall be FM approved, UL/ULC listed to control the release of extinguishing agents such as FM-200®, Inergen® or halon, as well as sprinkler pre-action or deluge systems. The releasing module shall provide:
  - .1 Two (2) supervised Class B Release circuits, 24Vdc @ 2A
  - .2 Two (2) supervised Class B Release circuits, 24Vdc @ 2A
  - .3 One (1) supervised Class B Normally-Open Alarm Latching Manual Release Input circuit
  - .4 One (1) supervised Class B Normally-Open Active Non-Latching Manual Abort Input circuit

.5 One (1) First Alarm Output relay, form C contact, 24Vdc @ 3A

.2 The releasing module shall be capable of standalone mode, which will maintain the operation of the module for manual release and abort inputs on loss of communication with the analog loop controller.

2.6 MICROPROCESSOR-BASED ADDRESSABLE MANUAL PULL STATIONS

.1 Fire Alarm / Life Safety System shall incorporate single stage microprocessor-based addressable Manual Pull Stations connected over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All Manual Pull Stations shall display communications and alarm status via LED's mounted on their integral, factory assembled module.

.2 All addressing of the Manual Pull Stations shall be done electronically, and the electrical location of each station shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the Manual Pull Station will not be dependent on their electrical location on the circuit.

.3 Provide intelligent single action single-stage fire alarm stations where shown on plans. The fire alarm station shall be of metal construction with an integral toggle switch to activate alarm signals. Stations shall be finished in red with silver "PULL IN CASE OF FIRE" lettering in English. The manual station shall be suitable for mounting on a North American 64 mm (2-½") deep, single-gang electrical box.

.4 All Manual Fire Alarm station shall be suitable for operation in the following environment:

.1 Temperature: 0ºC to 49ºC (32ºF to 120ºF)

.2 Humidity: 0-93% RH, non-condensing

2.7 FIRE ALARM NOTIFICATION APPLIANCES - GENERAL REQUIREMENTS

.1 All appliances which are supplied for the requirements of this specification shall be ULC Listed.

.2 All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturer's instructions.

.3 Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended.

.4 Self-Synchronized Horns and Strobes

.1 Provide electronic horn/strobes manufactured by GE Security, Genesis G1 Series or approved equal. Horn and strobe power shall be provided on one pair of wires. It shall be possible to control the horn (on, off and coded) independently from the strobe. The horn shall be selectable for continuous or synchronized temporal operation. The strobe shall be selectable for a continuous or temporal synchronized flash rate to match the horn and meet the intent of the National Building Code, Appendix Clause 3.2.4.20 (1).

.2 The horn shall provide an output of 94 dB peak using a low frequency tone for superior wall penetration. The strobe output shall be synchronized and available in 15, 30, 60, 75 &110 candela (cd) as listed on the plans. The light output shall be an even "Full Light" pattern throughout the strobes protected area. Strobes utilizing a traditional specular reflector with uneven light distribution are not acceptable.

.3 The horn/strobe shall be an ultra low profile single gang design, finished in UV stable neutral white and shall not protrude more than 25.4 mm (1") from the wall. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

.4 The devices shall mount to a standard single gang electrical box and have an optional trim ring for 2-gang, octagonal or 102 mm (4") square boxes. The signalling device series shall share a common appearance and be available in a horn, strobe or combination horn/strobe unit as listed on the plans.

.5 Speakers

.1 Speaker-Ceiling Mount-203 mm (8")

.1 Provide 203 mm (8") ceiling mounted speakers at the locations shown on the drawings. In and out screw terminals shall be provided for wiring. Speaker baffles shall be round or square steel with white finish as required. Provide square surface

mount boxes with matching finish where required. Speakers shall provide 1/2w, 1w, 2w, and 4W power taps for use with 70V systems. At the 4 watt setting, the speaker shall provide a 94 dBA sound output a frequency of 1000 Hz. when measured in an anechoic chamber at 3m (10 ft.).

.6 Speaker-Cone- 102 mm (4”)

.1 Provide 102 mm (4") white speakers at the locations shown on the drawings. Speakers shall have a 102 mm (4") mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 70V systems. At the 2 watt setting, the speaker shall provide an 88 dBA sound output over a frequency range of 400-4000 Hz.

.7 Speaker-Reentrant Surface

.1 Provide 102 mm (4") surface re-entrant speakers at the locations shown on the drawings. Speakers shall provide 2w, 4w, 8w, and 15w power taps for use with 70V systems. The re-entrant speakers shall utilize high efficiency compression drivers. Cone type drivers are not acceptable. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480. Weatherproof boxes shall be provided for outdoor mounting.

.8 Speaker-Strobes

.1 Provide speaker strobes where shown on plans and drawings. Strobe output shall be determined as required by its specific location and application from a family of 15/75cd, 30cd, & 110cd devices. Strobes shall provide a synchronized flash.

.9 Sirens

.1 Provide surface mounted fire alarm combination horn/sirens of the heavy duty electronic projector type at the locations shown on the drawings. The horn/siren shall be polarized for supervised operation. Select for horn or siren tone as required. Provide weatherproof wall boxes for outdoor mounting

2.8 SYSTEM PRINTER

.1 The event and status printer shall be a 9-pin, impact, dot matrix printer with a minimum print speed of 232 characters per second. The printer shall be capable of serial communications protocol. The printer shall list the time, date, type and user defined message for each event printed. The printer shall be located as shown on the plans.

.2 It shall be possible to define which system event types, (alarm, supervisory, trouble, and monitor events) are sent to the system printer.

.3 The printer shall be powered from 115 VAC, and shall include a UPS for emergency operation.

2.9 REMOTE LCD ANNUNCIATORS

.1 Remote LCD annunciators shall have the ability to duplicate all display and control functions of the main user interface located on the control panel. This includes the ability to control all system functions and duplicate panel annunciation.

.2 It shall be possible to define which system event types, (alarm, supervisory, trouble, and monitor events) are sent to each annunciator.

.3 Annunciator shall also include the ability to support programmable switches and or LED’s as required for special functions without the need to add additional wires or cabinets.

2.10 SHORT CIRCUIT ISOLATORS

.1 Addressable short circuit isolator with input and output wiring terminals, designed to automatically isolate wire-to-wire short circuits on a SLC loop, send an address to the control panel, and only disconnect devices connected to the short circuit loop while all other devices connected to the isolator loops will remain in operation. Each isolator is to mount in a standard 100 mm (4”) outlet box and is to be equipped with an identified stainless steel faceplate with LED that flashes when all circuits are normal and remains illuminated when a short circuit condition has been detected and isolated.

2.11 FIREMAN'S MANUAL SWITCHING STATION

.1 Flush wall mounting manual switching station with a brushed stainless steel faceplate and identified toggle switches for manual on/off or start/stop control of building equipment and systems associated with a fire alarm condition, i.e. smoke control fans and dampers, door locks, elevators, etc.

2.12 DOOR HOLD OPEN/RELEASE HARDWARE

.1 ULC listed hardware to suit the door type(s) and location(s).

2.13 WIRING

.1 In accordance with CSA C22.2 No. 208, CAN/ULC-S524, and governing Codes and Regulations, all electrically supervised, and as follows:

- .1 Power wiring to control panel and between panel and transponders, annunciators, etc.: Tyco "Pyrotenax" type MI two hour fire rated, mineral insulated, copper sheathed, copper conductor cable.
- .2 Communication wiring between control panel, transponders and to annunciators: Tyco "Pyrotenax" type MI, two hour fire rated, mineral insulated, copper sheathed, copper conductor cable.
- .3 Risers between network transponders: to include 2 hour fire rated single #18 AWG twisted shielded cable for each riser, in Class A style 6/7 identified loops, in addition to other fire rated conductors.
- .4 All other wiring unless otherwise specified: minimum 105ºC (220ºF) rated with copper conductors and colour coded insulation, and, unless otherwise shown or specified, sized in accordance with the fire alarm system manufacturer's instruction but in any case minimum No. 16 AWG.
- .5 Install all wiring in conduit, except M.I. cables, conduit sized to code. Minimum conduit size 19 mm (3/4").
- .6 Install alarm indicating circuits and alarm receiving circuits in separate conduits.
- .7 Provide end-of-line resistors to electrically supervise all wiring.
- .8 Ground and bond all system cabinets and other work to the building grounding system.

3 EXECUTION

3.1 INSTALLATION:

.1 The entire system shall be installed in accordance with the latest edition of CAN/ULC-S524 and the approved manufacturer's manuals and wiring diagrams. The contractor shall provide all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for a complete, functional life safety fire alarm system. Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Ontario Electrical Safety Code and the Inspection Authority. All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes. End-of-line resistors shall be provided as required for mounting as directed by the manufacturer.

3.2 TESTING AND INSPECTION:

.1 The manufacturer's representative shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal and smoke actuated detectors and controls, whether or not manufactured by the manufacturer. The inspection shall comprise an examination and test of such equipment for the following:

- .1 That the type of equipment installed is that designated by the specifications.
- .2 That the wiring connections to all equipment components show that the installer undertook to have observed ULC requirements.
- .3 That all products of combustion (smoke) detectors have been properly calibrated and adjustments set correctly.

.4 That the representatives equipment has been installed in accordance with the manufacturer's recommendations.
.5 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring having been met to the satisfaction of the inspecting officials.
.6 Testing to be done in the presence of the local building inspector and the local Fire Marshall.
.7 Fire alarm System shall be verified as per the latest issue of CAN/ULC-S537, Verification of Fire Alarm Systems standard.

3.3 SYSTEM PROGRAMMING

.1 Arrange for all required system programming to be done by the system manufacturer's technical representatives.

3.4 SYSTEM TESTING, CERTIFICATION, AND VERIFICATION

.1 The system manufacturer and an independent third party testing company are to test and verify the completed system. The independent third party testing company is to have primary responsibility for testing and verification.
.2 Commissioning, System Manufacturer's Testing and Verification: Accompanied by qualified personnel of the system manufacturer, the Commissioning Agent is to visually inspect the system for completeness, then test system operation, including all alarm initiating devices, signal devices, an all other system operations and functions. When the Commissioning Agent and system manufacturer confirm that the system is operating as intended, obtain from the Commissioning Agent and manufacturer and submit copies of signed test, inspection, and commissioning sheets, and a signed letter from the system manufacturer certifying that the system has been checked, tested, operated, adjusted, and is operating as intended, all as per CAN/ULC-S536. Qualified personnel system manufacturer's personnel are also to be available on-site to accompany independent third party personnel testing and verification.
.3 Independent Third Party System Testing and Verification: Retain and pay all costs for independent third party testing and verification of the system in accordance with CAN/ULC S537. The independent third party is to be a qualified and experienced testing agency with personnel trained in accordance with the Fire Alarm Technology Program of the Canadian Fire Protection Association, or Certified Fire Alarm Electricians certified by the Electrical Contractors Association of Ontario. All such personnel are to carry identification cards at all times while on-site. Third party independent testing and verification is to be responsible for:
    .1 Coordinating attendance at the site of all required fire inspection personnel so as to obtain their approval of testing and verifying work
    .2 Coordinating attendance at the site of system manufacturer's technical personnel to advise as required
    .3 Written confirmation that all alarm initiating devices, signals, paging, telephone, and all other components have been tested and operate properly
    .4 Written confirmation that all supervised wiring is properly installed and operating and is in accordance with all applicable requirements
    .5 Written confirmation that the overall system and sequences of operation, including operation of communication equipment, mechanical equipment, elevators, similar equipment as specified, battery power and charging have been tested and are in accordance with all requirements and meet with the approval of local governing authorities
    .6 Submittal of signed test report sheets and a signed Verification Certificate and approval documentation issued by the local Fire Authorities

3.5 LIABILITY INSURANCE POLICY

.1 Within fifteen days of written notification of award of contract, submit a Certificate of Insurance for a Commercial General Liability Insurance Policy from an insurer licensed to do business in the Province of the work and signed by an officer of the insurer covering public liability and property damage in a minimum amount of two millions dollars inclusive in Canadian funds and insuring all services, operations, products, and fire alarm system work. The policy is to be extended to include bodily injury, property damage, personal and advertising injury, products and completed operations, contractual

liability, Owners and Contractors protective liability and to a limit of not less than two million dollars Canadian per occurrence.

.2 The policy is to:

.1 Include a cross liability clause and be endorsed to include the Owner

.2 Include non-owned automobile insurance to a limit of not less than two million dollars Canadian

.3 Include automobile insurance (OAP1) for both owned and leased vehicles with inclusive limits of two million dollars Canadian

.4 Be non-contributing with and will apply only as primary and not excess to any other insurance or self-insurance available to the Owner

.5 Contain an undertaking by the insurers to notify the Owner in writing not less than thirty days before any material change in coverage or cancellation of coverage

END OF SECTION

PART 1 - GENERAL

1.1 Protection

.1 Prevent damage to existing site features which are to be retained such as fencing, bench marks, trees, landscaping, pavement, utility lines. Make good any damage.

1.2 Site Conditions

.1 Known underground and surface utility lines and buried objects are indicated on site plan and/or survey plan (approximate only). Contractor shall confirm locations and nature of all existing site services prior to commencement of work.

PART 2 - PRODUCTS- Not Used

PART 3 - EXECUTION

3.1 Preparation

.1 Inspect site and verify with Consultant items designated to remain, prior to commencement of work.

.2 Locate and protect utility lines. Preserve in operating condition active utilities traversing site.

3.2 Clearing and Grubbing

.1 Grub out stumps, roots, rubbish and other non-perishable material over 2" (50 mm) to minimum depth of 2'-0" (600 mm) below indicated finish grade from cleared areas. Remove embedded rocks less than 1 cubic yard (0.25 cubic m) encountered during clearing operations.

.2 Clear site free of trees, scrub plants, debris, rocks and stumps unless noted to be retained, prior to stripping operation.

.3 Dispose of cleared and grubbed material by hauling away from site. Pay all fees associated with excess soil material.

.4 Dispose of all excess materials legally. Pay all fees associated with entry and disposal at landfill site, as necessary.

End Of Section

PART 1 - GENERAL

1.1 Conform to Contract Requirements and Division 01 - General Requirements as part of this Section.

1.2 Work Included

.1 Perform site grading as shown and specified. The work includes:

.1 Rough grading fill material on-site to achieve a grade parallel to 150 mm (6") below the finish grade.

.2 Supply any required fill material to achieve the specified grade.

.3 Dispose of any material in excess of that required to achieve the specified grade.

1.3 Site Conditions

.1 Known underground and surface utility lines and buried objects are indicated on the site plan and/or survey plan (approximate only).

.2 It is the contractor's responsibility to arrange for locating all utilities prior to any construction.

.3 Promptly notify the Consultant of unexpected subsurface conditions.

1.4 Protection

.1 Locate and identify all on site utilities and features. Prevent damage to any natural features, fencing, trees, landscaping, bench marks, existing pavement, surface or underground utility lines, etc. which are to remain. Make good any damage incurred during or as a result of the construction operation.

PART 2 - PRODUCTS

2.1 Materials

.1 Fill Material: Type 3 fill as defined in Section 31 23 33 – Excavation, Trenching and Backfilling.

.2 Use only approved native or imported fill material. Fill material to be placed in layers not exceeding 6" (150 mm) and compacted to 98% SPMDD.

.3 Fill material will be permitted in pavement areas provided only if the depth of fill required exceeds 6" (150 mm). Otherwise a granular material specified by the Consultant shall be used.

PART 3 - EXECUTION

3.1 Removal of Topsoil

.1 Remove all topsoil from areas to be excavated in accordance to Section 31 23 33 Excavation, Trenching and Backfilling.

3.2 Grading

.1 Finish grade to levels, profiles and contours allowing for surface treatment as noted on the Tender Documents.

.2 Slope finish grade away from building 1:50 minimum.

3.3 Inspection and Testing

.1 Testing of materials and compaction will be carried out by a testing laboratory

designated by the Consultant. Frequency of tests will be determined by the Consultant.

3.4 Surplus Material

.1 Remove surplus or unsuitable material from site.

3.5 Maintenance

.1 Maintain grades shaped sufficiently well to allow continuous and complete drainage of the site without ponding, during and after grading operations.

END OF SECTION

PART 1 - GENERAL

1.1 Conform to Contract Requirements and Division 01 - General Requirements as part of this Section.

1.2 Work Included

.1 Excavating, backfilling and grading required for this work includes but is not necessarily limited to:

.1 Stripping topsoil from the construction area of the new building(s) and/or new construction and stockpiling same for future use.
.2 Trenching and trench backfilling for any storm sewers, water services, sanitary sewer, gas line and electrical service, including placing of granular beddings.
.3 Rough grading of the perimeter site of the area of work.

1.3 Related Work

.1	Section 31 22 13	-	Rough Grading
.2	Section 32 11 23	-	Aggregate Base Courses
.3	Section 32 12 16	-	Asphalt Paving
.4	Section 32 16 13.13	-	Cast-in-Place Concrete Curbs and Gutters
.5	Section 33 44 00	-	Storm Sewers

1.4 Protection of Existing Features

.1 Existing Buried Utilities and Structures:

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
.2 Prior to commencing any excavation work,
.3 Confirm locations of buried utilities by careful test excavations.
.4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. Obtain direction of Consultant before moving or otherwise disturbing utilities or structures.
.5 Advise Consultant prior to re-routing existing lines in area of excavation. Pay costs for such work.
.6 Record location of maintained, re-routed and abandoned underground lines.

.2 Existing buildings and surface features:

.1 Conduct, with Consultant, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

.2 Protect existing buildings and surface features which may be affected by work from damage while work is in progress and repair damage resulting from work.

.3 Where excavation necessitates root or branch cutting, do so only as approved by Consultant.

PART 2 - PRODUCTS

2.1 Fill Materials

.1 Type 1- to meet OPSS 1010 for Granular 'A'.

.2 Type 2 - to meet OPSS 1010 for Granular 'B'.

.3 Type 3 - Selected material from excavation for use intended, inert, unfrozen, and free from rocks larger than 75 mm (3"), cinders, ashes, organics or other deleterious material. The material must be capable of being compacted to 98% SPMDD and approved as suitable for use.

.4 Type 4 - Clean Coarse Sand.

.5 Filter Cloth – OPSS-1860.

2.2 Underground Materials

.1 Perforated Pipe: Corrugated High Density Polyethylene to OPSS 1840, CGSB 41-GP-25M and ASTM D1248.

.2 All subdrain pipe shall be fitted with a continuous knitted geotextile sock and conform to OPSS 1860.

2.3 Other Materials

.1 All other materials not specifically described but required for proper completion of the work of this Section shall be as selected by the Contractor subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 Site Preparation

.1 Remove obstructions, ice and snow from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.2 Stripping of Topsoil

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

.2 Commence topsoil stripping of areas as directed by Consultant after area has been cleared.

.3 Strip topsoil to depths as directed by Consultant. Avoid mixing topsoil with subsoil.

.4 Stockpile in locations as directed by Consultant.

.5 Dispose of unused topsoil off site.

3.3 Stockpiling

.1 Stockpile fill materials in areas designated by Consultant. Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

3.4 Dewatering

.1 Keep excavations free of water while work is in progress.

.2 Protect open excavations against flooding and damage due to surface run-off.

.3 Dispose of water in a manner not detrimental to public and private property or any portion of work completed or under construction.

.4 Submit for Consultant's review details of proposed dewatering methods.

.5 Well point systems and gas/diesel fired pumps are not permitted.

.6 Excavation below water table will not be permitted.

3.5 Excavation

.1 Excavate to lines, grades, elevations and dimensions as indicated.

.2 Remove concrete, masonry, walks, demolished foundations and rubble and other obstructions encountered during excavation.

.3 Excavation must not interfere with normal 45° splay of bearing from bottom of any footing.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.

.5 For trench excavation, unless otherwise authorized by Consultant in writing, do not excavate more than 30 m (100') of trench in advance of installation operations and do not leave open more than 6 m (20') at end of day's operation.

.6 Dispose of surplus and unsuitable excavated material off site.

.7 Do not obstruct flow of surface drainage or natural watercourses.

.8 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.9 Notify Consultant when soil at bottom of excavation appears unsuitable and proceed as directed by Consultant.

.10 Obtain Consultant approval of completed excavation.

.11 Remove unsuitable material from trench bottom to extent and depth as directed by Consultant.

.12 Where required due to unauthorized over excavation, correct as follows:

.1 Fill under bearing surfaces and footings with concrete specified for footings.
.2 Fill under other areas with Type 2 fill compacted to minimum of 98% SPMDD.

.13 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

3.6 Trenching

.1 Make all trenches open vertical construction with sufficient width to provide free working space at both sides of the trench and around the installed item as required for caulking, joining, backfilling and compacting.

.2 Where trench excavating is inadvertently carried below proper elevations, backfill with material approved by the Consultant and then compact to provide a firm and unyielding subgrade and/or foundation to the approval of the Consultant and at no additional cost to the Owner.

.3 Properly support all trenches in strict accordance with the Occupational Health and Safety Act.

.4 Brace, sheet, and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.

.5 In the event of damage to such improvements, immediately make all repairs and replacements necessary to the approval of the Consultant and at no additional charge to the Owner.

.6 Arrange all bracing, sheeting, and shoring so as to not place stress on any portion of the completed work until the general construction thereof has proceeded far enough to provide sufficient strength.

.7 Control the stockpile of trenched material in a manner to prevent water running into the excavations.

3.7 Foundation for Pipes

.1 Grade the trench bottoms to provide a smooth, firm and stable foundation free of rock points throughout the length of the pipe.

.2 Place bedding material in the trench, simultaneously on each side of the pipe for the full width of the trench, to a minimum depth of 300 mm (12”) above the outside diameter of the pipe barrel.

.3 After the pipe has been thoroughly bedded and covered, spread the on-site material in uniform lifts of not more than 300 mm (12”) in uncompacted thickness and then compact as specified in this Section.

3.8 Backfilling

.1 Do not allow or cause any of the work performed or installed to be covered up or concealed by work of this Section prior to all required inspections, tests and approvals, including proof rolling and geotechnical testing. Do not proceed with backfilling operations until Consultant has inspected and approved installations. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work at no additional cost to the Owner.

.2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris

.4 Place backfill material in uniform layers not exceeding 150 mm (6") compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.5 Backfilling around installations:

.1 Place bedding and surround material as specified elsewhere.
.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing.

.6 Place Type 2 Backfill above all pipe bedding and around all manholes and catch basins in areas to receive concrete slabs and foundations, concrete paving, stone paving and asphalt paving. Place Type 3 Backfill in all other locations.

3.9 Inspection and Testing

.1 Testing of materials and compaction will be carried out by a testing laboratory designated by the Consultant. Frequency of tests will be determined by the Consultant.

.2 Owner will pay costs for inspection and testing. Refer to Section 01 21 00 – Allowances

3.10 Restoration

.1 Upon completion of work, remove surplus materials and debris, trim slopes and correct defects noted by Consultant.

.2 Replace topsoil as directed by Consultant.

.3 Reinstate pavements, sidewalks and lawns to condition and elevation which existed before excavation.

.4 Clean and reinstate areas affected by work inside and outside the property line to a condition equal to or better than that which existed prior to construction. The restoration shall be to the satisfaction of the Consultant and Municipal Authorities.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Clearing & Grubbing: Section 31 11 00
.2 Hydroseeding: Section 32 91 19

1.2 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.

1.3 QUALITY CONTROL

.1 Contractor is responsible for soil analysis and requirements for amendments to supply topsoil as specified.
.2 Soil testing by recognized testing facility for PH, P and K, and organic matter.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.
.2 Divert unused soil from landfill.
.3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 TOPSOIL

.1 Topsoil for seeded areas: mixture of mineral particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
  .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20% to 70% sand, minimum 7% clay, and contain 2 to 10 % organic matter by weight.
  .2 Contain no toxic elements or growth inhibiting materials.
  .3 Free from:
    .1 Debris and stones over 50 mm diameter.
    .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
  .4 Consistence: friable when moist.

2.2 SOIL AMENDMENTS

.1 Fertilizer
  .1 Fertility: major soil nutrients present in following amounts:
  .2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
  .3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
  .4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
  .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
  .6 Ph value: 6.5 to 8.0.
.2 Peatmoss:
  .1 Derived from partially decomposed 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.

.3 Sand: washed coarse silica sand, medium to course textured.
.4 Limestone:
.1 Ground agricultural limestone.
.2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
.5 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

Part 3 Execution

3.1 STRIPPING OF TOPSOIL

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
.2 Commence topsoil stripping of areas as indicated after area has been cleared of brush weeds and grasses and removed from site.
.3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application.
.4 Stockpile in locations as directed by Owner's Representative. Stockpile height not to exceed 2 m.
.5 Disposal of unused topsoil.
.6 Protect stockpiles from contamination and compaction.

3.2 PREPARATION OF EXISTING GRADE

.1 Verify that grades are correct. If discrepancies occur, notify Owner's Representative and do not commence work until instructed by Owner's Representative.
.2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
.3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75 mm above surface. Dispose of removed material off site.
.4 Course cultivate entire area which is to receive topsoil to minimum depth of 100 mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

.1 Place topsoil after Owner's Representative has accepted subgrade.
.2 Spread topsoil in uniform layers not exceeding 150 mm, over unfrozen subgrade free of standing water.
.3 For sodded areas keep topsoil 50/100 mm below finished grade.
.4 Spread topsoil as indicated to following minimum depths after settlement and 80% compaction:
.1 150 mm for seeded areas.
.2 135 mm for sodded areas.
.3 300 mm for flower beds.
.4 500 mm for shrub beds.
.5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.4 FINISH GRADING

.1 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.
.2 Consolidate topsoil to required bulk density using equipment approved by Owner's Representative. Leave surfaces smooth, uniform and firm against deep footprinting.

3.5 ACCEPTANCE

.1 Owner's Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading. Approval of topsoil material subject to soil testing and analysis.

3.6 RESTORATION OF STOCKPILE SITES

.1 Restore stockpile sites acceptable to Owner's Representative.

3.7 SURPLUS MATERIAL

.1 Dispose of materials not required where directed by Owner's Representative.

3.8 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

End Of Section

Part 1 General

1.1 SUMMARY

.1 This section includes the following:

.1 Synthetic turf surfacing, for installation as a dog run, including:

.1 Aggregate base course.

.2 Perimeter board.

.3 Synthetic turf.

.4 Turf infill.

1.2 REFERENCES

.1 ASTM International (ASTM): www.astm.org:

.1 ASTM D1335 - Test Method for Tuft Bind of Pile Yarn Floor Coverings.

.2 ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

.3 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

.4 ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.

.5 ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Preinstallation Conference: Conduct conference at Project site following award of contract. Review methods and procedures related to synthetic turf surfacing installation including, but not limited to, construction schedule, availability of materials, equipment and facilities needed to make progress and avoid delays, installation procedures, inspection procedures, and coordination with other work.

1.4 ACTION SUBMITTALS

.1 Product Data: For each type of product specified.

.2 Shop Drawings: Provide installation details including roll and seaming layout, methods of attachment and details at penetrations and terminations

.3 Samples: For each type of synthetic turf surfacing indicated.

.1 Minimum 12-by-12-inch- square sample of synthetic turf surface with edge attachment and carpet seam.

.2 1/2 lb samples of base course and infill component material. Label sample identifying the material, its source, and evidence of compliance with specified product characteristics and testing

1.5 INFORMATIONAL SUBMITTALS

.1 Qualification Data: For Installer.

.2 Installation Schedule: Showing planned commencement and completion dates for each portion of the Work; include critical dates indicated on Owner's project schedule.

.3 Warranty: Sample warranty specified in this Section.

1.6 MAINTENANCE SUBMITTALS

.1 Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

.1 Seaming Materials: Sufficient quantity for 100 sq. ft.

.2 Synthetic Turf Fiber: Sufficient quantity for 100 sq. ft.

.3 Infill Material: Sufficient quantity for 100 sq. ft., in weatherproof bags.

.2 Maintenance Data: For synthetic grass surfacing system and maintenance equipment, to be included in maintenance manuals. Include the following:

.1 Manufacturer's written instructions manual for routine cleaning, adjustment, grooming, and other maintenance procedures. Include activities and procedures that could be detrimental to the synthetic grass surfacing system and should be avoided.
.2 Owner's manuals for field grooming and sweeping equipment.
.3 Warranty information for grooming and sweeping equipment.

.3 Project Record Drawings: Record locations of seams and drains.

.4 Warranty: 3 signed copies of signed warranty.

1.7 QUALITY ASSURANCE

.1 Manufacturer Qualifications: A firm experienced in manufacturing synthetic turf surfacing materials in applications similar to those specified for this project, with a record of successful service for a minimum of 5 years.

.2 Installer Qualifications: An experienced Installer certified by the manufacturer, employing workers trained and approved by manufacturer, who has successfully installed work similar in design and extent to that required for the project, in not less than 5 projects of similar scope.

.3 Source Limitations: Obtain synthetic turf surfacing materials through one source from a single manufacturer.

.4 Provide secondary materials including adhesives, paint, thread, and repair materials of type and from source recommended by manufacturer of synthetic turf surfacing materials.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to the site in original, unopened containers, wrapping, or packaging, with manufacturer's labels intact, identifying project, material, and production run or lot number for fabric roll.

.2 Immediately following delivery, inspect materials and components for damaged or defective items, including materials that are not uniform in color, out of tolerance regarding edge alignment and minimum pile height. Materials that are found to be damaged or defective shall be replaced at no additional cost to the Owner.

.3 Store materials in a secure, dry, well-ventilated location where protected from weather, exposure to UV, soil, dust, moisture and other contaminants. Store fabric rolls horizontally, on a flat surface. Store infill materials indoors, in a secure, ventilated location to ensure materials will remain dry.

.4 Handle according to manufacturer's recommendations to prevent damage, deterioration, distortion, or soiling.

1.9 PROJECT CONDITIONS

.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit synthetic turf surfacing installation to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

.1 Coordinate installation of synthetic turf surfacing's with installation of site paving, playground equipment, adjacent lawns, landscaping materials, site lighting, and related work.

1.11 WARRANTY

.1 Manufacturer's Warranty: Submit manufacturer's standard published limited warranty form in which manufacturer agrees to repair or replace components of synthetic turf surfacing installation installed by manufacturer-certified Installer that fail in materials under normal use and maintenance, or provide other relief, within specified warranty period.

.1 Failures include ultraviolet degradation, backing integrity, more than 50 percent loss of face fiber, and loss of tuft bind strength.
.2 Warranty Period: Life of product.

.2 Installer Project Warranty: Submit synthetic turf surfacing Installer's warranty, signed by Installer, covering the Work of this Section, including installation of all components of synthetic turf surfacing system, for the following warranty period:
.1 Warranty Period: Two years from date of Substantial Completion.

Part 2 PRODUCTS

2.1 MANUFACTURERS

.1 Basis of Design Manufacturer: Subject to requirements of this Section, provide listed products of SYNLawn, Dalton GA 30721; (866) 796-5296; info@synlawn.com; www.synlawn.com or approved alternate.
.1 Submit requests for substitution in accordance with Instructions to Bidders and Division 01 General Requirements.

.2 Source Limitations: Obtain synthetic turf surfacing materials through one source from a single manufacturer.
.1 Provide secondary materials including adhesives, paint, thread, and repair materials of type and from source recommended by manufacturer of synthetic turf surfacing materials.

2.2 PERFORMANCE REQUIREMENTS

.1 Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

.2 Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.
.1 Provide synthetic turf system meeting requirements of ASTM F1951.

2.3 SYSTEM DESIGN

.1 Synthetic grass surfacing system specifically designed and recommended by the manufacturer for installation as a dog run.

.2 Synthetic grass surfacing system constructed to maximize dimensional stability, to resist damage during normal use, and to minimize UV degradation, including fading.

.3 Synthetic grass surfacing system resistant to staining, weather, insects, rot, mildew, and fungus growth, and shall be non-allergenic and non-toxic.

2.4 SYNTHETIC TURF SURFACING

.1 Synthetic Turf Surfacing: Complete surfacing system, consisting of delustered UV-stabilized antimicrobial synthetic yarns bound to water-permeable bio-based primary and secondary backing. IPEMA-certified. Non-abrasive blades with low surface temperature. Anti-Static and Ultra Violet reflective pigment-enhanced.
.1 Basis of Design Product: SYNLawn Pet Platinum.
.2 Artificial Turf Fiber and Construction Characteristics:
.1 Yarn, Turf Zone: Polyethylene, omega shape.
.1 Color: Field green + apple.
.2 Color, Trim: Tan.
.3 Denier, ASTM D1577: 10,800/6.
.4 Antimicrobial Protection: Sanitized®
.5 Antistatic Protection: StatBlock™

.6 IR Reflective: DualChill™

.2 Yarn, Thatch Zone: Polyethylene.
.1 Color: Field green + Beige.
.2 Denier, ASTM D1577: 5000/8.
.3 Finished Pile Height, ASTM D5823: 1-1/2 inch.
.4 Finished Pile Weight, ASTM D5848: 80 oz/sq. yd.
.5 Tuft Machine Gauge: 3/8 inch.
.6 Backing, Primary:13/18 polypropylene, 2 layers with fiber-reinforcing core.
.7 Backing, Secondary: 22 oz. bio-based urethane.
.1 Enviroloc+™
.1 Anti Fungi and Anti Algae blended into secondary backing.
.8 Total Weight: 108 oz./sq. yd.

.3 Performance Characteristics:
.1 Tuft Bind, ASTM D1335: Not less than 8 lb.
.2 Grab tear strength, ASTM D5034: Not less than 200 lbf.
.3 Elongation to break, ASTM D2256: Not less than 30 percent.
.4 Yarn breaking strength, ASTM D5793: Not less than 20 lb.
.5 Flammability, ASTM D2859: Pass.
.6 Fire Test Exposure, ASTM E108: Class A.
.7 Heavy Metal Analysis, EN71-3

.2 Infill Material: Synthetic antimicrobial treated silica sand infill in manufacturer's recommended formula for application to synthetic turf surfacing.

.3 Glue, Seaming Fabric, and Thread: As recommended by manufacturer for application.

2.5 BASE SYSTEM MATERIALS

.1 Aggregate Base Course: Sound crushed graded stone or gravel complying with ASTM D 448 for Size No. 8 or ASTM D 448 for Size No. 57.

.2 Aggregate Top Course: Decomposed granite fines.

.3 Perimeter Nailer Board: Manufacturer's approved wood/polymer composite nailer/edger board, size as shown on Drawings, but not less than 2 by 4 nominal.

.4 Turf Spikes: Manufacturer's approved soil spikes, 12 inches long.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Examine synthetic turf surfacing base and perimeter conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
.1 Verify substrate meets profile required.
.2 Confirm base material, compaction of substrate, permeability, and drainage system installation meets requirements.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SUBBASE AND AGGREGATE COURSE PREPARATION

.1 General: Prepare substrates to receive surfacing products according to synthetic turf surfacing manufacturer's written instructions. Verify that substrates are sound and without high spots, ridges, holes, and depressions. Remove organic debris. Grade soil subgrade level and compact.

.2 Finish grade soil subgrade with slope between 0.5 percent and 1.0 percent toward path of site drainage.

.3 Place aggregate base course, compact by tamping with plate vibrator to 90 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated. Install 4-inch base course unless otherwise indicated.

.1 Slope base course between 0.5 percent and 1.0 percent, measured from the longitudinal center of the installation towards the edges. Grade base course to tolerance of within 0.5 inch of design grade, and with a maximum variation of 0.25 inch in 10 feet in any direction.

.4 Install perimeter nailer board as indicated on approved shop drawings, using soil nails of size and spacing indicated.

3.3 SYNTHETIC TURF INSTALLATION

.1 General: Comply with synthetic turf surfacing manufacturer's written installation instructions. Install synthetic turf surfacing over area and in thickness indicated.

.2 Synthetic Turf: Loose-lay artificial turf and allow fabric to relax for period recommended by manufacturer. Stretch carpet; spot adhere to drainage mat and attach at perimeter in accordance with approved submittals.

.3 Seaming: Form seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Form seams as recommended in synthetic turf manufacturer's written instructions using manufacturer's provided or recommended materials.

.4 Attachment: Attach turf fabric to perimeter restraint system and fasten in the field of the turf as indicated on approved submittals.

3.4 INSTALLATION, INFILL

.1 Mix and install infill material components in accordance with manufacturer’s requirements for approved system. Groom material and leave surface ready for use.

3.5 PROTECTION

.1 Protect completed installation from damage. Prevent traffic over system prior to acceptance by Owner.

3.6 DEMONSTRATION

.1 Instruct Owner's personnel in proper inspection and maintenance of synthetic turf surfacing. Review manufacturer’s recommended maintenance procedures and warranty terms and conditions.

End Of Section

Part 1 General

1.1 REFERENCE DOCUMENTS

.1 The following documents, referenced in the Section, are published by the Master Painters Institute (MPI)
- .1 Architectural Specification Manual
- .2 Maintenance Repainting Manual
- .3 Approved Product List

1.2 QUALITY ASSURANCE

.1 Materials and workmanship for new work shall meet or exceed requirements of the APS Manual

.2 Materials and workmanship for maintenance shall meet or exceed requirements of the MR Manual

1.3 DELIVERY, STORAGE and HANDLING

.1 Deliver materials in sealed original labeled containers bearing manufacturer's name, type of material, brand name and colour designation.

Part 2 Products

2.1 MATERIALS

.1 Materials are specified by the designated MPI systems, with colours specified herein.

.2 Only products listed in the MPI "Approved Product List" are acceptable for use.

.3 Colour for new work
- .1 Parking Lines to Municipal Standards

Part 3 Execution

3.1 PROTECTION OF EXISTING WORK

.1 Protect structures, buildings, sidewalks, landscaping and other surface features against spillage and over-spray during painting operations

.2

3.2 APPLICATION OF PAVEMENT LINE MARKINGS

.1 Clean pavement surface as recommended by paint manufacturer.

.2 Paint lines straight and uniform width, at locations indicated on drawings.

.3 Apply paint using marking machine or line stencil to a minimum of 0.18 mm dry film thickness.

.4 Line Width:
- .1 Parking areas: 4", except where otherwise indicated.

3.3 CLEAN-UP

.1 Remove spillage and over-spray of paint from pavement, sidewalks, building and other site features. Use methods and materials without damaging and / or leaving visible residue on substrate.

.2

3.4 PROTECTION OF COMPLETED WORK

.1 Keep traffic off pavement markings for a time as recommended by paint manufacturer.

End Of Section

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect fence and gate materials from damage.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials.

Part 2 Products

2.1 WIRE FENCE

.1 Fabric: Type 1 Class A, Top and bottom salvage to have knuckled finish.

.2 Line Posts: 2 ½" outside diameter, standard butt-weld Schedule 40 pipe, galvanized, 33" longer than fabric.

.3 Terminal Posts: 3 ½ diameter, standard butt-weld Schedule 40 pipe, galvanized, 3'-6" longer than fabric height.

.4 Concrete footings: 10" diameter by 4'-0" deep 20 MPa.

.5 Line Post Tops: galvanized pressed steel, maleable iron or cast. Top to accommodate 3 ¼" outer diameter top rail in horizontal position.

.6 Top Rail: 1 11/16" outer dimension galvanized pipe, plan ends, random lengths, standard butt-weld Schedule 40 pipe.

.7 Fittings: hot dipped galvanized pressed steel, aluminum or non-metallic mouldings of sufficient strength to ensure the integrity of the fence.

.8 Tension wire: number 6 gauge, wire shall be stretch taut along the bottom of the fabric and fastened at 1'-6" intervals.

.9 Hinges, latches etc. as required for gate installation. Gate to be self closing.

.10 Gates and Gate frames: to ASTM A53, galvanized steel pipe, Pipe size to be 1 11/16" in diameter, powder-coated finish.

.1 Fasten fence fabric to gate with Knuckle top.

.2 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of Installed gate. Gates to be self closing with barrier free Accessible latches.

.11 Fittings and hardware: cast aluminum alloy, galvanized steel or malleable or ductile cast iron. Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail. Overhang tops to provide waterproof fit, to hold top rails and an inward projection to hold barbed wire overhang. Provide projection with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart. Projection of approximately 300 mm long to project from fence at 45° above horizontal. Turnbuckles to be drop forged.

.12 Organic zinc rich coating: to CGSB 1-GP-181M.

1.2 FINISHES

.1 All components: Galvanized 9ga.

Part 3 Execution

3.1 GRADING

.1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface neither less than 1 ¼" (30 mm) nor more than 2" (50 mm).

3.2 ERECTION OF FENCE

.1 Erect fence along lines as indicated.

.2 Excavate post holes 4'-0" (1200 mm) depth x 10" (254 mm) diameter by methods approved by Consultant.

.3 Space line posts 10'-0" (3 m) apart, measured parallel to ground surface.

.4 Space straining posts at equal intervals not exceeding 50'-0" (15 m) if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 50'-0" (15 m).

.5 Install additional straining posts at sharp changes in grade and where directed by Consultant.

.6 Install corner post where change in alignment exceeds 10 degrees.

.7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.

.8 Place concrete in post holes then embed posts into concrete to minimum 4-0' (1200 mm) depth. Extend concrete 2" (50 mm) above ground level and slope to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.9 Do not install fence fabric until concrete has cured a minimum of 5 days.

.10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface. Install braces on both sides of corner and straining posts in similar manner.

.11 Install top rail between posts and fasten securely to terminal posts and secure waterproof caps and overhang tops.

.12 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

.13 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.

.14 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 18" (450 mm) intervals. Give tie wires minimum two twists.

.15 All bolted connections to be sized so that when tightened, the bolt does not protrude beyond the nut by more than two threads.

3.3 INSTALLATION OF GATES

.1 Install gates in locations as indicated.

.2 Level contours between gate posts and set gate bottom approximately 1 ½" (40 mm) above ground surface.

.3 Install gate stops where indicated.

.4 All bolted connections to be sized so that when tightened, the bolt does not protrude beyond the nut by more than two threads.

3.4 CLEANING

.1 Clean and trim areas disturbed by operations. Dispose of surplus material.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Clearing & Grubbing: Section 31 11 00
.2 Topsoil Placement & Fine Grading: Section 31 91 19
.3 Hydroseeding: Section 32 91 19

1.2 DELIVERY AND STORAGE

.1 Deliver grass seed in original containers showing:
  .1 Analysis of seed mixture.
  .2 Percentage of pure seed.
  .3 Year of production.
  .4 Net weight.
  .5 Date when tagged and location.

.2 Sod Delivery and Storage:
  .1 Schedule deliveries in order to keep storage at jobsite without causing delays.
  .2 Deliver, unload and store sod on pallets.
  .3 Deliver sod to site within 24 hours of being lifted and lay sod within 36 hours of being lifted.
  .4 Do not deliver small, irregular or broken pieces of sod.
  .5 During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.
  .6 During dry weather, protect sod from drying and water sod as required to ensure its vitality and prevent dropping of sod in handling. Dry sod will be rejected.

1.3 SOURCE QUALITY CONTROL

.1 Obtain approval of sod at source.
.2 When proposed source of sod is approved, use no other source without written authorization.

1.4 SCHEDULING

.1 Schedule sod laying to coincide with preparation of soil surface.
.2 Schedule sod installation when frost is not present in ground.

1.5 WASTE MANAGEMENT AND DISPOSAL

.3 Divert unused fertilizer from landfill to official hazardous material collections sites.
.4 Do not dispose of unused fertilizer into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 MATERIALS

.1 Sod: Number 1 Kentucky Blue Grass fescue sod; sod grown from min. 40% Kentucky Blue Grass 30% Creeping Red fescue of Nursery Sod Quality and Source to comply with standards outlined in Guide Spec. for Nursery Stock, Section 17, 1978 edition, published by Canadian Nursery Trades Association.
.2 Water: potable.
.3 Fertilizer: Complete synthetic slow release fertilizer with maximum 35% water soluble nitrogen. Delivery to site in standard size bags, showing weight, analysis and name of manufacturer.
.5 Topsoil: as per section 31 91 19 Topsoil Placement & Fine Grading.

Part 3 Execution

3.1 WORKMANSHIP

.1 Keep site well drained. Keep landscape excavations dry.

.2 Clean up immediately soil or debris spilled onto pavement and dispose of deleterious materials.

3.2 PREPARATION

.1 Fine grade subgrade to eliminate uneven areas, low spots and ensure positive drainage. Remove debris, roots, branches, stones in excess of 50 mm diameter and deleterious materials. Obtain review prior to placing topsoil.

3.3 SODDING

.1 Obtain approval of topsoil grade and depth, from Landscape Consultant before starting sodding.

.2 Lay sod during growing season. Sodding during dry summer period, at freezing temperatures or over frozen ground is not acceptable.

.3 Lay sod in rows, smooth and even with adjoining areas, and with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.

.4 Provide close contact between sod and soil by means of light rolling. Heavy rolling to correct irregularities is not permitted.

.5 Water immediately after sod laying to obtain moisture penetration through sod into top 100 mm of topsoil.

.6 Provide adequate protection of sodded areas against erosion and mechanical damage. Remove protection after lawn areas have been accepted.

3.4 MAINTENANCE

.1 Keep soil moist during germination period and water lawns frequently during remaining maintenance period.

.2 Apply water in sufficient quantities to ensure moisture penetration of 3" to 4". Control sprinkling to prevent wash-outs.

.3 Cut grass first time when it reaches height of 2 1/2" and cut thereafter frequently enough to maintain height of 1 1/2" top 2". Remove clippings which will smother grassed areas.

.4 Apply herbicide when it will not cause damage to new grass or other plants. Apply during calm weather when air temperature is above 10 C, when broad leaf weeds start developing. Prevent drifting of spray, repair damage to grass and plants.

- .1 Use 2, 4-D Amine herbicide for susceptible broadleaf weeds. Apply at manufacturer's recommended rate.
- .2 Use 2, 4-D plus propionic acid mixtures herbicide for chickweed, clover, black medick and other 2, 4-D resistant plants. Apply at manufacturer's recommended rate.
- .3 Avoid use of dicamba and picloram solutions near trees and shrubs.
- .4 Use only mecocrop on Bentgrass turf areas.

.5 Fertilize seeded areas one month after Seeding with 2:1:13 ration fertilizer. Spread evenly at rate of 0.5 kg of nitrogen/100 m2 and water in well. Postpone fertilizing until next spring if application fails within four week period prior to expected end of growing season in locality.

3.5 ACCEPTANCE

.1 Lawn areas will be accepted by Consultant provided that:

- .1 Areas of sod and seed are properly established.
- .2 Turf is free of bare and dead spots and without weeds.
- .3 No surface soil is visible when grass has been cut to height of 1 1/2".

.4 Sodded areas have been cut at least twice, the last cut being carried out within 24 hours of acceptance.

.2 Lawns sodded in fall will be accepted in following spring one month after the start of growing season provided acceptance conditions are fulfilled.

.3 Sodded areas deemed unacceptable will be resodded and seeded areas deemed unacceptable will be reseeded and subject to all of the above conditions from the date of replacement.

End Of Section

Part 1 General

1.1 RELATED SECTIONS

Topsoil Placement, Fine Grading, Seeding

1.2 SUBMITTALS

.1 Submit Submittals in accordance with Section 01 33 00 - Submittal Procedures

.2 Product Data.

.1 Provide product data for:

.1 Seed.

.2 Mulch.

.3 Tackifier.

.4 Fertilizer

1.3 QUALITY ASSURANCE

.1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.2 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

1.4 SCHEDULING

.1 Schedule hydraulic seeding to coincide with preparation of soil surface.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Divert unused fertilizer from landfill to official hazardous material collections site as approved by the Ministry of the Environment or governing body.
Do not dispose of unused fertilizer into sewer systems, into lakes, streams or in locations where it will pose health or environmental hazard.

1.6 WARRANTY

.1 All areas hydroseeded under this contract shall have a warranty period of one (1) year from the date of acceptance and shall cover any defects in materials and workmanship or damages caused by the elements of weather. All defects shall be repaired to the satisfaction of the Consultant at no cost to the Owner.

Part 2 Products

2.1 MATERIALS

.1 Seed: "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and local regulations

.1 Grass mixture composition:

.1 50 % Creeping Red Fescue

.2 20 % Red Top.

.3 15% Canada Blue Grass

.4 15 % Kentucky Blue Grass

.2 Mulch: specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors with following properties:

.1 Type I mulch:

.1 Made from wood cellulose fibre.

.2 Organic matter content: 95% plus or minus 0.5%.

.3 Value of pH: 6.0.

.4 Potential water absorption: 900%.

.2 Type II mulch: straw.

.3 Use either Type I or Type II mulch.

.3 Tackifier: water dilutable, liquid dispersion or water soluble vegetable carbohydrate powder.
.4 Water: free of impurities that would inhibit germination and growth.
.5 Fertilizer:
.1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
.2 Complete synthetic, slow release with 35% of nitrogen content in water insoluble form.
.6 Imported Topsoil: friable, neither heavy clay or of very light sandy nature, containing a minimum of 4% organic matter for clay loams and 2% for sandy loams to a maximum of 20% volume. Free from subsoil, roots, grass, weeds, toxic materials, stones, foreign objects and with an acidity range, PH of 5.5 to 7.5. Topsoil containing crabgrass, couphgrass or noxious weeds is not acceptable.

Part 3 Execution

3.1 WORKMANSHIP

.1 Do not spray onto structures, signs, guide rails, fences, plant material, utilities and other than surfaces intended.
.2 Clean-up immediately, any material sprayed where not intended, to satisfaction of Consultant.
.3 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water. Protect seeded areas from trespass until plants are established.

3.2 PREPARATION OF SURFACES AND PLACEMENT OF TOPSOIL

.1 Fine grade subgrade to eliminate uneven areas, low spots and ensure positive drainage. Remove debris, roots, branches, stones in excess of 2" (50 mm) diameter and deleterious materials. Obtain review prior to placing topsoil.
.2 Spread topsoil evenly over area to be seeded to minimum thickness of 4" (100 mm).
.3 Fine grade entire topsoil to eliminate uneven areas and low spots. Ensure positive drainage and provide a uniform, smooth finish.
.2 Roll topsoil with 110 lb (50 kg) roller, minimum 36" (900 mm) wide to compact and retain surface.
.2 Cultivate area to be seeded to depth of 1" (25 mm).
.3 Ensure areas to be seeded are moist to depth of 6" (150mm) before seeding.

3.3 FERTILIZING PROGRAM

.1 Fertilize prior to fine grading, equally distributed.

3.4 PREPARATION OF SLURRY

.1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Consultant. Supply equipment required for this work.
.2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.
.3 After all materials are in the seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.5 SLURRY APPLICATION

.1 Hydraulic seeding equipment:
.1 Slurry tank.
.2 Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and/or mechanical agitation method.

.3 Capable of seeding by 165' (50 m) hand operated hoses and appropriate nozzles.
.4 Tank volume to be certified by certifying authority and identified by authorities "Volume Certification Plate".

.2 Slurry mixture applied per hectare.
.1 Seed: Grass mixture 330 lb (150 kg).
.2 Mulch: Type I or II 2755 lb (1250 kg).
.3 Tackifier: 44 lb (20 kg).
.4 Water: Minimum 6600 imp. gal. (30,000 L).
.5 Fertilizer: 1323 lb (600 kg), ratio 5:20:10

.3 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.
.1 Using correct nozzle for application.
.2 Using hoses for surfaces difficult to reach and to control application.

.4 Blend application 12" (300 mm) into adjacent grass areas to form uniform surfaces.

.5 Re-apply where application is not uniform.

.6 Remove slurry from items and areas not designated to be sprayed.

.7 Protect seeded areas from trespass satisfactory to Consultant

.8 Remove protection devices as directed by Consultant.

3.6 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following operations from time of seed application until acceptance by Consultant.

.2 Grass Mixture:
.1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
.2 Mow grass to 2" (50 mm) whenever it reaches height of 2 3/4" (70 mm). Remove clippings which will smother grass.
.3 Fertilize seeded areas 10 weeks after germination provided plants have mature true leafs. Spread half of required amount of fertilizer in one direction and remainder at right angles; water in well. Date and time of fertilization must be approved by Owner prior to execution.
.4 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices. If chemical means are to be utilized, the date and time of weed control must be approved by Owner prior to execution.
.5 Contractor to water seeded area to maintain optimum soil moisture level for germination and continued growth of grass for a minimum of 10 weeks after time of seeding. Control watering to prevent washouts.

3.7 ACCEPTANCE

.1 Seeded areas will be accepted by Consultant provided that:
.1 Plants are uniformly established. Seeded areas are free of rutted, eroded, bare or dead spots.
.2 Areas have been mown at least twice.
.3 Areas have been fertilized.

.2 Areas seeded in fall will achieve final acceptance in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.8 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until end of warranty period:
.1 Repair and reseed dead or bare spots to satisfaction of Consultant.

.2 Fertilize seeded areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.

3.9 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

End Of Section

PART 1 General

1.1 Description

.1 This Section specifies furnishing and installing porcelain tactile walking surface indicators, where indicated.

1.2 References

.1 Canadian Standard Association (CSA) B651-12
.2 Accessibility for Ontarians Disability Act (AODA) 413-12
.3 International Standards Organization (ISO) 23599:2012(E)

1.3 Compliance

.1 Tile must fulfill requirements of the following tile organizations:
1. PCTA (Porcelain Tile Certification Agency)
2. TTMAC (Terrazzo Tile & Marble Association of Canada)

1.4 Submittals

.1 Product Data: Submit manufacturer's literature for each type of product indicated, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Cleaning methods and materials.
5. Routine maintenance.

.2 Shop Drawings: Show locations of each type of tile and tile pattern, setout point for installation of tiles, and coordination for alignment between differing tile types. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tie substrates and finished tile surfaces.

.3 Selection Samples for Verification Purposes: Submit one (1) full size samples of each type of tile.

.4 Manufacturer's Certificate: When applicable, submit a Master Grade Certificate signed by the manufacturer and the installer certifying that products meet or exceed the specified requirements of ANSI A137.1.

.5 Installer Qualifications: Company specializing in performing the work of this section with minimum two years' experience.

1.5 Quality assurance

1. Installer Qualifications: Company specializing in performing the work of this Section with documented evidence of previous similar installations. Employ skilled installers trained and experienced in the installation of tile work with minimum three (3) years documented experience.
2. Single Source Responsibility:
    1. Tile: Obtain each type and color of tile from a single source. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
    2. Setting and Grouting Materials: Obtain ingredients of a uniform quality for each type of mortar, adhesive and grout from a single source.
3. Performance requirements to achieve EN 14411

Length & Width	ISO 10545-2	± 0,1%
Thickness	ISO 10545-2	3%
Straightness	ISO 10545-2	± 0,2%
Rectangularity	ISO 10545-2	± 0,2%
Surface Flatness	ISO 10545-2	± 0,2%

Water Absorption	ISO 10545-3	0,01% to 0,04%
Modulus of Rupture	ISO 10545-4	$\geq$ 40N/mm^2
Impact Resistance	ISO 10545-5	Resistant
Abrasion Resistance	ISO 10545-6	$\leq$ 125 mm^3
Coefficient of Linear Thermal Expansion	ISO 10545-8	$\leq$ 8x10^{-6}
Thermal Shock Resistance	ISO 10545-9	Resistant
Fracture Resistance	ISO 10545-11	Resistant
Frost Resistance	ISO 10545-12	Resistant
Chemical Resistance	ISO 10545-13	Resistant
Stain Resistance	ISO 10545-14	Class 5
Slip Resistance	DIN 51130	R11 (>19º - 27º)
	ASTM C1028	< 0.8
Surface Hardness (Mohs Scale)	EN 101	$\geq$ 9
Cadmium and Lead Release	ISO 10545-15	Resistant

1.6 Delivery, Storage, and Handling

.1 All material shall be packaged in means that will prevent damage and protect the product from any damage or deterioration.

.2 Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

.3 Store tiles on elevated platforms, under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

1.7 Environmental Requirements

.1 Maintain minimum temperature of 50 degrees F (10 degrees C) in spaces to receive porcelain tiles for at least 48 hours prior to installations, during installation, and for not less than 48 hours after installation. Subsequently, maintain minimum temperature of 50 degrees F for a minimum of 7 days after completion.

.2 VOC emissions levels must receive A+ Ecolabel certification.

PART 2 Products

2.1 Tactiles

.1 Exterior Tile: Detectable warning tile with 25 truncated domes with a 60mm center to center spacing (in-line). Nominal 300mm x 300mm x 10mm (14mm high at domes). Based Armor Tile Tactile cast in place by Kinesik Engineered Products Incorporated or approved alternate

2.2 Setting and Grouting Materials

.1 A per Manufacturer's recommendations

2.3 Mixing Mortars and Grout

.1 Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

.2 Add materials, water, and additives in accurate and consistent proportions per manufacturer's written instructions.

.3 Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 Execution

3.1 Examination

.1 Acceptability of Surfaces: Inspect surfaces to be tiled to ensure proper bonding can be achieved, and to verify that surfaces are free of curing membranes, oil, grease, wax and dust.

.2 Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with contractor.

.3 Substrate Tolerances: Before tiling, inspect surfaces to be tiled to verify that the following tolerances are not exceeded. If tolerances are exceeded, provide specified leveling coat to achieve specified tolerances.

1. Floors: 1/8 inch in 10 feet (3 mm in 3 m) for dry-set mortar and epoxy; 1/16 inch in 3 feet (1.5 mm in 1 m) for organic adhesive.

3.2 Preparation

.1 Layout: Layout tile work to minimize cuts less than one-half tile in size.

.2 Field-Applied Temporary Protective Coating: Where indicated or needed to prevent grout from staining or adhering to exposed tile surfaces, pre-coat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

.3 Provide full weather protection and maintain temperature ranges during preparation of the work areas. Provide tarping, tenting, and temporary heat as required during installation and curing as described in Section 1.7: Environmental Requirements.

3.3 Installation

.1 ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

.2 TTMAC 2012-2014 Tile Installation Specification Guide 09 30 00. Comply with installation methods and details.

1. Refer to notes on pages 10 – 14 and Detail 301 MJ-2-002 in TTMAC Manual.

.3 General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing 2012-2014 Tile Guide installation methods and ANSI A108 Series of tile installation standards.

.4 Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit closely to electrical outlets, piping fixtures, and other penetrations so plates, collars, or covers overlap tile.

.5 Jointing Pattern: Lay tile in grid pattern unless indicated otherwise. Align joints when adjoining tiles on floor, base, walls and trim are same size. Lay out tile work and centre tile fields in both directions in each space or on each wall area unless indicated otherwise. Provide uniform joint widths unless indicated otherwise.

.6 Joint Widths - not greater than 6.0 mm ± 1.5mm.

3.4 Cleaning and protection

.1 Cleaning: On completion of placement and grouting, clean porcelain tile surfaces so they are free of foreign matter. Remove grout residue from tile as soon as possible.

.2 Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions.

.3 Protection: Prohibit foot and wheeled traffic from floors for a minimum of 24hrs.

.4 Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

End Of Section

Englobe
Soils Materials Environment

Brant County SPCA

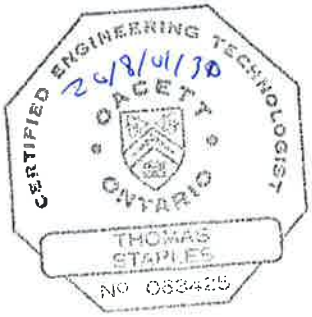
BRANT COUNTY SPCA AND CITY OF BRANTFORD POUND
KRAEMERS WAY
BRANTFORD, ONTARIO

JANUARY 2018

Geotechnical Investigation Report

160-P-0015102-0-01-100-GE-R-0001-00

Englobe



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Property and Confidentiality

Table of Contents

Tables

Appendices

1 Introduction

Englobe Corp. (Englobe) was retained by Brant County SPCA to carry out a geotechnical investigation for the proposed new SPCA facility and future City of Brantford Pound located at Kraemers Way, Brantford, Ontario (Drawing 1 – Appendix A).

2 General Information

The project involves the proposed construction of a single storey 1080 m^2 slab-on-grade building for the SPCA and a 730 m^2 slab-on-grade building for the City of Brantford Pound. Asphalt parking lots will be constructed in front of the buildings and access driveways will be constructed from Kraemers Way as shown on Drawing 2 in Appendix A.

The purpose of this investigation was to explore the subsurface soil and groundwater conditions at the subject site and prepare a geotechnical report. The geotechnical report includes recommendations on building design and construction, site servicing, pavement design, and construction and inspection testing.

The subject site is located at the northwest corner of Oak Park Road and Kraemers Way in the City of Brantford's Northwest Industrial Park. The site slopes down from the west to the east with a topographical relief of approximately 1.0 m at the borehole locations.

3 Field and Laboratory Investigation

3.1 Previous Work

In 2007, Naylor Engineering Associates Limited (NEA) conducted a Geotechnical Investigation at the site. The fieldwork involved the drilling of seven boreholes (Boreholes 101 to 107). The results of the investigation are provided in Naylor Engineering Associates Limited (Report No. 2860G12.R01 dated January 2007).

In 2007, Naylor Engineering Associates Limited provided inspection and testing services during area grading of the subject lot. The results are provided in Naylor Engineering Associates Limited File No. 2860C24.

The relevant geotechnical information from the above noted report/file has been incorporated into this report. The relevant borehole logs are provided in Appendix B and the borehole locations are provided on Drawing 2 in Appendix A.

3.2 Field Program

The fieldwork for this investigation was completed on January 3 and 4, 2018 and involved drilling of thirteen boreholes (Boreholes BH-01-18 to BH-12-18 and BH-03B-18) to depths of approximately 2.0 to 5.0 m. The borehole locations are shown on Drawing 2 – Appendix A. The field investigation was carried out in general conformance with the professional standards set out in the Canadian Foundation Engineering Manual (CFEM 2006, 4th Edition), applicable Ontario Regulations and the American Standard Testing Method (ASTM). The following is a summary of field investigation tasks:

- Local utility companies were contacted prior to the start of drilling activities in order to demarcate underground utilities on the site.
- The boreholes were advanced using a Geoprobe drillrig equipped with continuous flight hollow stem augers supplied and operated by Direct Environmental Drilling Inc. under the supervision of an Englobe drilling supervisor. The boreholes were logged by our geotechnical supervisor.
- The boreholes were located relative to existing site features and property lines and were surveyed upon completion by Englobe. The ground surface elevations are referred to the following temporary benchmark (TBM) provided by Antech Design and Engineering (Drawing 2 – Appendix A).

  TBM: Top of manhole cover on Kraemers Way west of Oak Park Road as shown on Drawing 2 in Appendix A.

  Elevation: 241.33 m (geodetic)
- Soil samples were recovered from the boreholes at regular depth intervals using a 50 mm outside diameter split spoon sampler in accordance with ASTM – D1586 – Standard Penetration Test (SPT). The recorded SPT N-values are provided on the borehole logs (Appendix B).
- Groundwater observations were made and measurements were carried out in the open boreholes during and upon completion of drilling and noted on the borehole logs.
- The boreholes were backfilled with soil cuttings and bentonite in accordance with Ontario Regulation 903 as amended, under the Ontario Water Resources Act.

3.3 Laboratory Testing

The soil samples secured during this investigation were returned to our laboratory for visual examination, as well as moisture content tests. A total of 55 moisture content tests were performed and these results are plotted on the borehole logs (Appendix B).

Two particle size analyses were conducted on selected samples, and the results are summarized in Section 4.1 (Subsurface Conditions) and plotted on Figure 1 in Appendix C.

It is important to note that as per the standard policy of Englobe, the soil samples will be stored for a period of three months from the date of sampling. These soils samples will be discarded after the three month period unless prior arrangements have been made for longer storage.

4 Subsurface Conditions

4.1 Subsoil Conditions

This section presents a brief summary of the subsurface soil and groundwater conditions encountered during the geotechnical investigation. The full details of the subsoil and groundwater conditions are presented on the borehole logs in Appendix B. Based on results of the geotechnical field investigation, the subsurface soils consists of fill typically underlain by native granular soil deposits and glacial till.

Fill was encountered in all of the boreholes and typically ranges in thickness from 1.1 to 2.3 m. The fill extends to the 2.0 m termination depths of Boreholes BH-08-18 and BH-11-18. Fill material comprises moist, compact to very dense sand and gravel with trace silt to silt with some sand and gravel. SPT N-values for the fill range from 13 to 52 blows per 300 mm penetration of a split spoon sampler.

The fill is underlain by native soils comprising damp to moist, dense to very dense sand, sand and gravel, and compact to very dense glacial till. The SPT N-values within the sand and gravel materials range from 33 to 98 blows per 300 mm and SPT N-values in the glacial till typically range from 20 to 85 blows per 300 mm.

The results of two particle size analyses carried out on samples of the granular soils are provided in Appendix C and indicate the samples contain 33 to 36% gravel, 41 to 45% sand, and 13 to 18% silt.

4.2 Groundwater

Groundwater observations and measurements carried out in the open boreholes are summarized on the appended borehole logs. No free groundwater was encountered in the open boreholes indicating the stabilized groundwater level is below the depth of exploration.

It is important to note that the groundwater conditions described in this report refer only to those observed at the place and time of observation noted in the report. These elevations and conditions may vary locally due to seasonal fluctuations, groundwater regimes encountered at the site or as a consequence of construction activities on the site or adjacent sites.

5 Geotechnical Design Recommendations

This project involves the proposed construction of a single storey slab-on-grade building for the Brant County SPCA and a single storey slab-on-grade building for the City of Brantford Pound. Parking lots will be constructed adjacent to the front of the buildings and access driveways will be constructed from Kraemers Way. Proposed founding elevations and finished grades were not available at the time of report preparation, however, it is anticipated that proposed final grades will approximate existing grades. The pre-existing fill encountered at the site was placed as engineered fill during earth grading of the property in 2007.

5.1 Bearing Capacity

Footings founded on approved existing or new structural fill or approved compact to very dense native soils may be designed for soil bearing resistance at Serviceability Limit States of 150 kPa, and a factored geotechnical resistance at Ultimate Limit States of 225 kPa, where the resistance factor is equal to 0.5.

A Site Classification 'D' should be used for earthquake load and effects in accordance with Table 4.1.8.4.A of the Ontario Building Code (2012).

5.2 Concrete Slab-on-Grade

The floor slab for the new buildings may be constructed using conventional concrete slab-on-grade techniques following removal of the surficial vegetation and inspection of the subgrade soil. A modulus of subgrade reaction (k) of 35 MPa/m may be used for the design of the floor slabs on the compact granular soils. The slab-on-grade floor should be independent of all load-bearing walls and columns.

No underfloor drains are required provided the exterior grades are lower than the finished floor slab and positively sloped away from the building.

To prevent the migration of moisture vapour into the building from beneath ground floor slabs, particularly where moisture sensitive floor coverings are placed, a vapour retarder shall be placed directly beneath the floor slab that meets the requirements of the designer and flooring manufacturer. Prior to installing moisture sensitive floor coverings, the moisture content of the concrete slab must be determined at operational conditions by internal relative humidity testing to ensure an acceptable slab moisture level. It should be noted that it typically takes more than 90 days at operational conditions to lower the slabs internal relative humidity to 85%. Different flooring systems have different responses to slab moisture (i.e. some systems can tolerate more moisture than others), and the flooring contractor must assess the floor moisture levels with respect to their flooring components.

The water to cement ratio and slump of the concrete utilized in the floor slab should be strictly controlled to minimize shrinkage of the slab. Control joints should be sawed into the slab at maximum 4 m spacing's within 12 hours of initial concrete placement in order to pre-locate shrinkage cracks. The saw-cut depths should be ¼ of the slab thickness. The slab should be wet-cured for seven days to minimize problems with shrinkage and curling.

During placement of concrete at the construction site, testing should be performed to determine the slump, temperature, and air entrainment of the concrete; and concrete cylinders should be cast for compressive strength testing.

5.3 Pavement Design

Asphalt parking lots will be will be constructed adjacent to the front of both buildings and access driveways will extend from Kraemers Way to both parking lots. It is understood that the asphalt areas will be used for light duty vehicular traffic only. In the event that heavy vehicles will be used on the pavements, the following pavement designs should be revised.

Any existing surficial vegetation and organic soil, and loose soils should be removed from below the pavement areas and if required, grades should be raised with approved on-site inorganic soils or imported granular materials. The subgrade fill should be placed in 200 mm thick lifts compacted to 100% standard Proctor maximum dry density (SPMDD).

The pavement component thicknesses in Table 1 are recommended based on the anticipated pavement usage, the frost-susceptibility, and strength of the subgrade soils.

Table 1 Pavement Component Thicknesses

Pavement Component	Asphalt Surfaced Areas
	Thickness (mm)
Hot-Mix Asphalt	90
Granular A Base Course	150
Granular B Type I Subbase Course	300

Samples of both the Granular A and Granular B Type 1 aggregates should be checked for conformance to OPSS.MUNI 1010 prior to utilization on site and during construction. The Granular B Type 1 subbase and Granular A base courses must be compacted to 100% (SPMDD), as verified by insitu density testing.

The hot-mix asphalt should comprise 50 mm of HL4 or HL8 binder and 40 mm of HL3 surface. The hot-mix asphalt paving materials should conform to the requirements of OPSS 1150. The asphalt should be placed and compacted in accordance with OPSS 310. Performance graded asphalt cement (PGAC) 58-28 should be utilized in the hot mix asphalt in accordance with the recommendations of OPSS 1101.

The pavement subgrade and granular courses will lose their strength to support traffic loads if allowed to become wet due to surface water or groundwater infiltration; therefore, drainage of the pavement and the granular courses is essential. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped to provide effective drainage. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas.

The need for continuous paving supervision by a qualified pavement technician, and quality control testing during pavement construction cannot be over emphasized. All materials and construction services required for the work should be in accordance with the applicable sections of the Ontario Provincial Standard Specifications.

6 Construction Recommendations

6.1 Excavations and Dewatering

All trench excavations and excavations for foundations must comply with Ontario Regulation 213/91 (Construction Projects) under the Occupational Health and Safety Act. The predominant granular soils contacted in the boreholes would be classified as Type 3 soils (O.Reg. 213/91, s. 226(4)). Temporary cut slopes should be at a slope of 1:1 (H:V) or flatter as per O.Reg. 213/91, s. 234(2). If saturated deposits are exposed, the cut slopes will have to be sloped back to 3:1 (H:V).

Based on results of the geotechnical investigation, it is not anticipated that groundwater will be encountered in open excavations for service installation. However, minor groundwater seepage may be encountered (due to seasonal variations) and may be controlled using conventional sump pumping and trenching techniques. Surface runoff should be directed away from any open excavations.

6.2 Pipe Bedding

The subgrade soils beneath the service pipes should comprise engineered fill or native soil, and support problems are not anticipated for flexible or rigid pipes indirectly supported by these soils.

Prior to installation of the services, the subgrade should be inspected by an experienced Geotechnical Engineer/Technician. If any organic soils, loose or soft areas are encountered during inspection they should be excavated and replaced with compacted granular material such as OPSS.MUNI 1010 Granular A.

The pipe bedding for the services should be conventional Class B pipe bedding comprising a minimum 150 mm thick layer of OPSS.MUNI 1010 Granular A aggregate below the pipe invert. The bedding course may be thickened if portions of the subgrade become wet during excavation. OPSS.MUNI 1010 Granular A type aggregate should be provided around the pipe to at least 300 mm above the top, and the bedding should be compacted to 100% SPMDD. Service lines installed outside of heated areas should be provided with a minimum 1.2 m of soil cover or equivalent insulation for frost protection.

6.3 Trench Backfill

The trenches above the specified pipe bedding should be backfilled with inorganic soils placed in 200 mm thick lifts and compacted to at least 98% SPMDD. Where the service trenches enter the building, the trench backfill must be compacted as structural fill to a minimum of 100% SPMDD. Any trench backfill below the pavement structure should be compacted to 100% SPMDD within 1 m of the top of subgrade. Based on the results of insitu moisture content tests carried out on the native overburden deposits and existing inorganic fill, the materials are considered suitable for reuse as trench backfill. Organic material (topsoil) is not considered suitable for reuse as trench backfill and if encountered, shall be separated.

To minimize potential problems, backfilling operations should follow closely after excavation so that only a minimal length of trench is exposed. Care should be taken to direct surface runoff away from the excavations. Should construction extend into the winter season then backfilling operations should be planned to ensure that backfill material is kept to a minimum and ensured that frozen material is not used as backfill.

Frequent inspection and compaction testing by experienced geotechnical personnel should be carried out to examine and approve backfill material, and to verify that the specified degree of compaction has been achieved.

6.4 Foundations

The following recommendations are given based on results of the geotechnical investigation:

- Prior to construction of the foundations any unsuitable material including surficial vegetation and fill exhibiting topsoil characteristics, and loose soils shall be excavated from within the building footprint. The subgrade should be inspected and approved by an experienced geotechnical engineer/ technician upon excavation.
- Fill material within the building must be placed on approved subgrades as structural fill under full time geotechnical supervision. The structural fill should comprise onsite sand or sand and gravel soils, placed in 200 mm thick lifts and compacted to 100% SPMDD.
- Compaction testing by experienced geotechnical personnel should be carried out to examine and approve structural fill materials, and to verify that the specified degree of compaction has been achieved.
- The footing areas must be inspected by a qualified geotechnical engineer/technician at the time of construction to confirm soil conditions encountered and recommended bearing capacity.
- All exterior footings and those exposed to freezing should be provided with minimum of 1.2 m of soil cover to provide protection from freezing. If construction extends into the winter months, all founding soil must be protected from freezing during construction.
- The materials excavated from the foundation trench areas may be suitable for reuse as foundation wall backfill. The backfill should be placed in 200 mm thick lifts and compacted to 95% SPMDD on the exterior of the building and 100% SPMDD on the interior of the building. The backfill should be placed evenly on both sides of walls that are not designed to resist lateral earth pressure. Over-compaction must be avoided since this could cause excessive lateral earth pressure.

6.5 Construction Inspection and Testing

During construction of the new building, testing should be carried out for quality assurance. Soils testing for the project would include engineering site visits to confirm bearing capacity for footings for the new buildings. Compaction testing shall be carried out on structural fill beneath the building, foundation wall backfill, sub-slab granular fill, service pipe bedding and trench backfill, and granular materials beneath the paved areas.

During the placement of concrete at the construction site, testing should be performed to determine the slump and air content of the concrete, and concrete cylinders should be cast for compressive strength testing in accordance with the requirements of CSA A23.1 and A23.2. Field sampling and testing of concrete shall be according to OPSS 904. Preparation of the test cylinders, curing, and testing should be carried out by Englobe.

Englobe maintains CSA/CCIL certified concrete laboratories in Kitchener and London, and can provide concrete sampling and testing services for the project as required. Englobe staff also provide quality testing services for building envelope, structural steel, reinforcing steel, and roofing.

7 Statement of Limitations

The geotechnical recommendations provided in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known at the time of report preparation, we recommend that we be retained during the final design stage to verify that the geotechnical recommendations have been correctly interpreted in the design. Also, if any further clarification and/or elaboration are needed concerning the geotechnical aspects of the project, Englobe should be contacted. We recommend that we be retained during construction to confirm that the subsurface conditions do not deviate materially from those encountered in the test holes and to ensure that our recommendations are properly understood.

The geotechnical recommendations provided in this report are intended for the use of the owner and its retained designer. They are not intended as specifications or instructions to contractors. Any use which a contractor makes of this report, or decisions made based on it, are the responsibility of the contractor. The contractor must also accept the responsibility for means and methods of construction, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect their work. Englobe accepts no responsibility and denies any liability whatsoever for any damages arising from improper or unauthorized use of the report or parts thereof.

It is important to note that the geotechnical investigation involves a limited sampling of the site gathered at specific test hole locations and the conclusions in this report are based on this information gathered. The subsurface geotechnical, hydrogeological, environmental and geologic conditions between and beyond the test holes will differ from those encountered at the test holes. Also such conditions are not uniform and can vary over time. Should subsurface conditions be encountered which differ materially from those indicated at the test holes, we request that we be notified in order to assess the additional information and determine whether or not changes should be made as a result of the conditions.

Appendix A Drawings

Drawing 1: Site Plan
Drawing 2: Borehole Location Plan

NOTES :

1-REFERENCE: © OpenStreetMap contributors (2018)

2-Drawing scale may be distorted due to file conversion and/or copying. Measurements taken from the drawing must be verified in the field.

0 200 400 600 800 1000 m

SCALE 1:30,000

Project

Brant County SPCA and City of Brantford Pound

Kraemers Way, Brantford, Ontario

Title

LOCATION PLAN

Englobe

440, Hardy Road, Unit 3
Brantford (Ontario) N3T 5L8
Telephone : 519.720.0078
Fax : 519.720.0976

Prepared	K. Staples	Discipline	Geotechnical	Project manager	T. Staples
Drawn	K. Staples	Scale	1 : 30,000	Sequence no.	01 of 02
Checked	T. Staples	Date	2018-01-25		

M. dept.	Project	Disc.	Dwg no.	Rev.
160	P-0015102-0-01-100	GE	001	00

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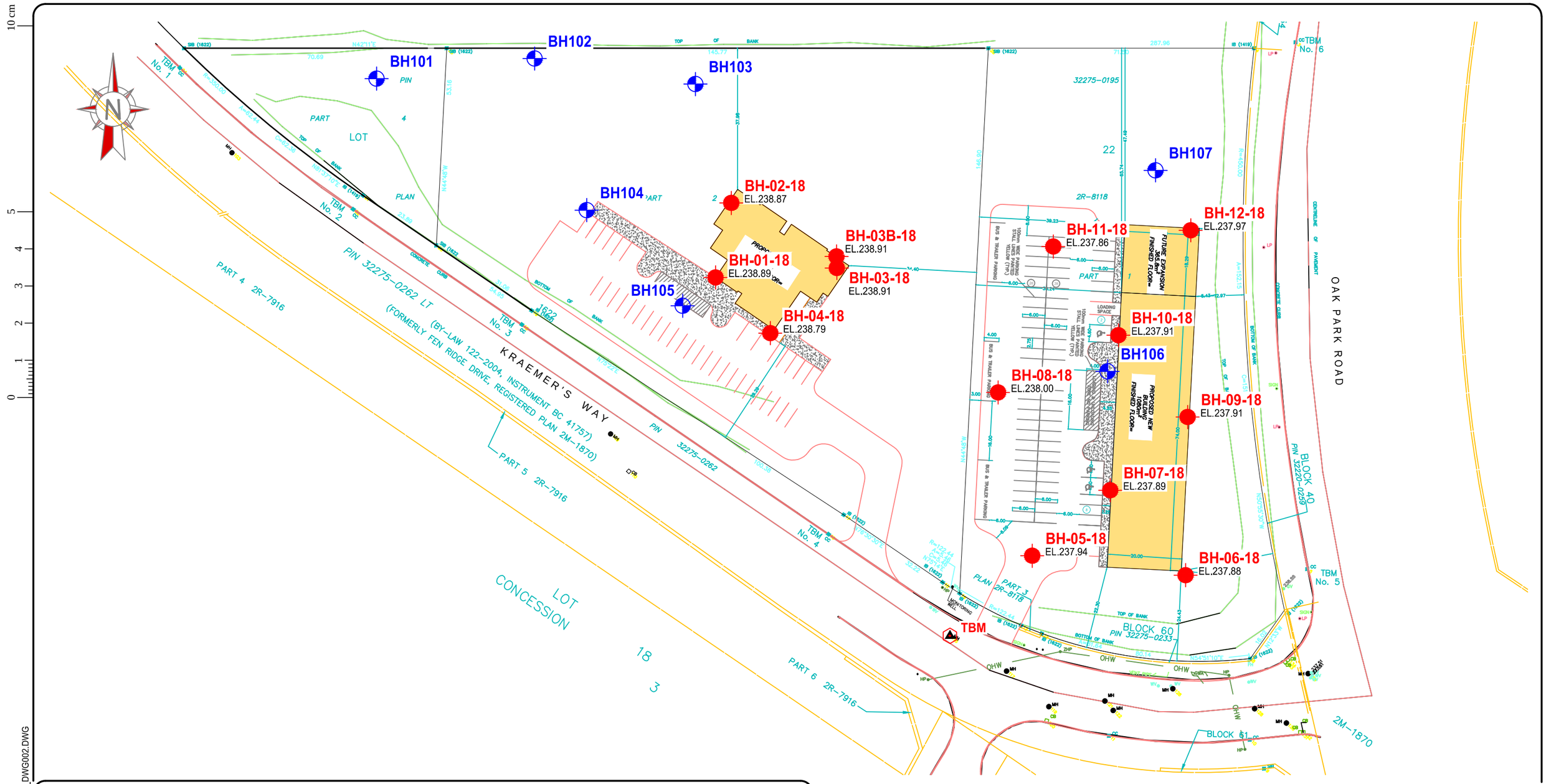

LEGEND :

- CURRENT BOREHOLE LOCATION (APPROXIMATE)
- PREVIOUS BOREHOLE LOCATION (APPROXIMATE) (NEA Project Number 2860G12, January 2007)
- EL.238.89 GROUND SURFACE ELEVATION (m)
- TBM TEMPORARY BENCHMARK

NOTES:

1-REFERENCE: Base drawing provided by Antech Design & Engineering Group on December 21, 2017; Drawing Number 164713 dated October 23, 2017; Filename: 164713-10KraemersWay-PLCV-Share-2017.11.20.dwg

2-TEMPORARY BENCHMARK : Top of manhole cover west of the intersection of Kraemers Way and previous Oak Park Road. Elevation: 241.33 m (Geodetic)

3-Drawing scale may be distorted due to file conversion and/or copying. Measurements taken from the drawing must be verified in the field.

0 10 20 30 40 50 m

SCALE 1:1000

Project

Brant County SPCA and City of Brantford Pound

Kraemers Way, Brantford, Ontario

Title

SITE PLAN

Englobe
440, Hardy Road, Unit 3
Brantford (Ontario) N3T 5L8
Telephone : 519.720.0078
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Prepared	K. Staples	Discipline	Geotechnical
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Checked	T. Staples	Date	2018-01-19

Project manager: T. Staples
Sequence no.: 02 of 02

M. dept.	Project	Disc.	Dwg no.	Rev.
160	P-0015102-0-01-100	GE	002	00

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Appendix B Borehole Logs

List of Abbreviations
Boreholes BH-01-18 to BH-12-18, and BH-03B-18
Borehole logs from Naylor Engineering Associates Limited
Report No. 2860G12.R01 - Boreholes 101 to 107

LIST OF ABBREVIATIONS

The abbreviations commonly employed on the borehole logs, on the figures, and in the text of the report, are as follows:

Sample Types		Soil Tests and Properties	
AS	Auger Sample	SPT	Standard Penetration Test
CS	Core Sample	UC	Unconfined Compression
RC	Rock Core	FV	Field Vane Test
SS	Split Spoon	ø	Angle of internal friction
TW	Thinwall, Open	γ	Unit weight
WS	Wash Sample	w_p	Plastic limit
BS	Bulk Sample	w	Water content
GS	Grab Sample	w_L	Liquid limit
WC	Water Content Sample	I_L	Liquidity index
TP	Thinwall, Piston	I_p	Plasticity index
		PP	Pocket penetrometer

Penetration Resistances	
Dynamic Penetration Resistance	The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) diameter 60º cone a distance 300 mm (12 in.). The cone is attached to 'A' size drill rods and casing is not used.
Standard Penetration Resistance, N (ASTM D1586)	The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) required to drive a standard split spoon sampler 300 mm (12 in.)
WH	sampler advanced by static weight of hammer
PH	sampler advanced by hydraulic pressure
PM	sampler advanced by manual pressure

Soil Description		
Cohesionless Soils	**SPT N-Value**	**Relative Density (D_r)**
Compactness Condition	(blows per 0.3 m)	(%)
Very Loose	0 to 4	0 to 20
Loose	4 to 10	20 to 40
Compact	10 to 30	40 to 60
Dense	30 to 50	60 to 80
Very Dense	over 50	80 to 100
Cohesive Soils	**Undrained Shear Strength (C_u)**	
Consistency	**kPa**	**psf**
Very Soft	less than 12	less than 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000
DTPL	Drier than plastic limit	Low Plasticity, W_L <30
APL	About plastic limit	Medium Plasticity, 30 < W_L < 50
WTPL	Wetter than plastic limit	High Plasticity, W_L > 50

Englobe

Ground Elevation: *238.89 m*

Borehole Number: **BH-01-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-03*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		238.89			
	FILL: dense light brown silty sand with gravel, moist; piece of asphalt		0.00			
1	brown silt, some sand, trace gravel, moist		237.82 / 1.07	SS-1	18-23 / 23	46
			237.37			
	SAND AND GRAVEL: very dense brown sand and gravel, trace silt, damp		1.52	SS-2	50-25 / 38 /*	63
2						
			236.30	SS-3	18-31 / 40	71
	silty sand and gravel, moist		2.59			
	sand and gravel, trace silt, damp		236.15 / 2.74			
3						
				SS-4	27-32 / 29	61
4						
			234.32			
	dense		4.57	SS-5	15-14 / 29	43
5			233.86			
	Borehole terminated at 5.03 m.		5.03			
6						
7						
8						

Dynamic Cone: 20 40 60 80

Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200

Initial

Remold

Shear Strength (FV) kPa: 50 100 150 200

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

bentonite seal

native cave

At drilling completion, dry cave at 4.57 m.

Vertical Scale = 1 : 50.0

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes: ** driving on gravel in spoon tip*

Englobe

Ground Elevation: *238.87 m*

Borehole Number: **BH-02-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-03*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		238.87			
	FILL: very dense brown silty sand and gravel, moist		0.00			
				SS-1	23-26 24	50
			237.35			
	compact brown silt, some sand and gravel, moist		1.52	SS-2	7-6 7	13
			236.58			
	SAND AND GRAVEL: dense brown sand and gravel, some silt, moist		2.29	SS-3	21-25 21	46
			235.82			
	compact, trace silt, damp		3.05	SS-4	10-9 9	18
			235.21			
	very dense		3.66			
			234.15	SS-5	55 /150mm	
	Borehole terminated at 4.72 m.		4.72			

Dynamic Cone — 20 40 60 80
Std Penetration — 20 40 60 80
Shear Strength (PP) kPa — 50 100 150 200
Initial
Remold
Shear Strength (FV) kPa — 50 100 150 200
WP WL
Water Content (%) — 10 20 30

Groundwater Observations and Standpipe Details

- native backfill
- bentonite seal
- native cave

At drilling completion, dry cave at 4.27 m.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

Z:\Style_LVM_OntarioLog Borehole_Log_LVM_Ontario.sty - Printed : 2018-01-29 13 h

Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *238.91 m*

Borehole Number: **BH-03-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-03*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		238.91			
	FILL: compact brown silt, some sand and gravel, moist		0.00			
			238.00			
1	trace topsoil		0.91	SS-1	7-12 8	20
2				SS-2	5-10 16	26
			236.47			
	SAND AND GRAVEL: very dense brown sand and gravel, some silt, damp *sampler driving on gravel		2.44	SS-3	70 /75mm	
3			235.86			
	Borehole terminated at 3.05 m.		3.05			
4						
5						
6						
7						
8						

Dynamic Cone — Std Penetration — 20 40 60 80

Shear Strength (PP) kPa — Initial — Remold — Shear Strength (FV) kPa — 50 100 150 200

WP — WL — Water Content (%) — 10 20 30

Groundwater Observations and Standpipe Details

native backfill

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes: *Borehole continued on January 4, 2018 at Borehole BH-03B-18.*

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *238.91 m*

Borehole Number: **BH-03B-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *J. Marcos*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		238.91			
	(unsampled)		0.00			
			235.86			
	SAND AND GRAVEL: dense brown sand and gravel, some silt, damp		3.05	SS-1	12-22 22	44
			234.34			
	very dense silty sand and gravel, moist		4.57	SS-2	18-22 42	64
			233.88			
	Borehole terminated at 5.03 m.		5.03			

Dynamic Cone — Std Penetration — 20 40 60 80

Shear Strength (PP) kPa — Initial — Remold — Shear Strength (FV) kPa — 50 100 150 200

WP — WL — Water Content (%) — 10 20 30

Groundwater Observations and Standpipe Details

At drilling completion, dry cave at 3.05 m with no free groundwater encountered.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes: *Straight augered to 3.05 m and continued sampling to termination depth.*

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *238.79 m*

Borehole Number: **BH-04-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *J. Marcos*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		238.79			
	FILL: compact brown silty sand, trace gravel, moist		0.00			
				SS-1	5-8 8	16
				SS-2	8-12 13	25
			236.81			
	SAND: very dense brown gravelly sand, some silt, damp		1.98			
				SS-3	10-32 50	82
			235.74			
	SAND AND GRAVEL: very dense sand and gravel, trace silt		3.05	SS-4	15-35 22	57
				SS-5	15-50 48	98
			233.76			
	Borehole terminated at 5.03 m.		5.03			

Dynamic Cone: 20 40 60 80

Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200

Initial / Remold

Shear Strength (FV) kPa: 50 100 150 200

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

native cave

At drilling completion, dry cave at 2.74 m with no free groundwater encountered.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

Z:\Style_LVM_OntarioLog Borehole_Log_LVM_Ontario.sty - Printed : 2018-01-29 13 h

Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *237.94 m*

Borehole Number: **BH-05-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-03*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value	Groundwater Observations and Standpipe Details
	Ground Elevation		237.94				
	FILL: compact brown sand and gravel, trace silt, moist		0.00				native backfill
1				SS-1	9-14 12	26	
							native cave
			236.11	SS-2	6-16 16	32	
2	***SAND AND GRAVEL:*** dense brown sand and gravel, trace silt, damp		1.83 235.96				At drilling completion, dry cave at 1.07 m.
	Borehole terminated at 1.98 m.		1.98				
3							
4							
5							
6							
7							
8							

Dynamic Cone — Std Penetration: 20 40 60 80

Shear Strength (PP) kPa — Initial / Remold — Shear Strength (FV) kPa: 50 100 150 200

WP — WL — Water Content (%): 10 20 30

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

Z:\Style_LVM_OntarioLog Borehole_Log_LVM_Ontario.sty - Printed : 2018-01-29 13 h

Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *237.88 m*

Borehole Number: **BH-06-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		237.88			
	FILL: dense brown sand and gravel, trace silt, moist		0.00			
			236.97			
1	brown silt, some sand and gravel, moist		0.91	SS-1	12-20 19	39
			236.68			
	sand and gravel, trace silt		1.20			
			236.05	SS-2	14-27 32	59
2	***SAND AND GRAVEL:*** very dense sand and gravel, some silt, damp		1.83			
			235.59			
	dense		2.29	SS-3	10-20 22	42
3						
			234.53	SS-4	10-20 21	41
	trace silt		3.35			
4						
			233.31			
	SAND: dense brown sand, trace gravel and silt, moist		4.57	SS-5	7-15 23	38
5			232.85			
	Borehole terminated at 5.03 m.		5.03			
6						
7						
8						

Dynamic Cone: 20 40 60 80
Std Penetration: 20 40 60 80
Shear Strength (PP) kPa: 50 100 150 200
Initial
Remold
Shear Strength (FV) kPa: 50 100 150 200
WP WL
Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

- native backfill
- bentonite seal
- native cave
- At drilling completion, dry cave at 2.74 m.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

Z:\Style_LVM_OntarioLog Borehole_Log_LVM_Ontario.sty - Printed : 2018-01-29 13 h

Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *237.89 m*

Borehole Number: **BH-07-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		237.89			
	FILL: dense brown silty sand, some gravel, moist		0.00 / 236.82	SS-1	7-18 17	35
	SAND AND GRAVEL: dense sand and gravel, trace silt, damp		1.07 / 236.37			
	silt layer		1.52 / 235.60	SS-2	10-21 25	46
	dense brown sand and gravel, trace silt, damp		2.29 / 234.69	SS-3	11-21 20	41
	SAND: dense brown sand, trace silt and gravel, moist		3.20 / 233.32	SS-4	6-13 20	33
	SILT TILL: very dense grey silt, some sand, trace gravel, moist		4.57 / 232.86	SS-5	24-50 /150mm	
	Borehole terminated at 5.03 m.		5.03			

Dynamic Cone: 20 40 60 80 — Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200 — Initial / Remold — Shear Strength (FV) kPa: 50 100 150 200

WP WL — Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

native cave

At drilling completion, dry cave at 3.66 m.

Vertical Scale = 1 : 50.0

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

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EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *238.00 m*

Borehole Number: **BH-08-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *J. Marcos*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		238.00			
	FILL: dense brown sand and gravel, trace silt, moist		0.00			
				SS-1	10-19 18	37
			236.48			
	compact		1.52	SS-2	13-13 15	28
			236.02			
	Borehole terminated at 1.98 m.		1.98			

Dynamic Cone — Std Penetration — 20 40 60 80

Shear Strength (PP) kPa — Initial — Remold — Shear Strength (FV) kPa — 50 100 150 200

WP — WL — Water Content (%) — 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

At drilling completion, no free groundwater encountered.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

Z:\Style_LVM_OntarioLog Borehole_Log_LVM_Ontario.sty - Printed : 2018-01-29 13 h

Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *237.91 m*

Borehole Number: **BH-09-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		237.91			
	FILL: compact brown sand and gravel, trace silt, moist		0.00			
				SS-1	8-16 10	26
			236.39			
	dense, some silt		1.52	SS-2	10-20 21	41
			235.62			
	SAND AND GRAVEL: dense brown sand and gravel, trace silt, moist		2.29	SS-3	10-21 25	46
			234.71			
	silt layers, moist		3.20	SS-4	9-16 25	41
			233.34			
	dense silty sand and gravel, moist		4.57	SS-5	13-16 22	38
			232.88			
	Borehole terminated at 5.03 m.		5.03			

Dynamic Cone — 20 40 60 80

Std Penetration — 20 40 60 80

Shear Strength (PP) kPa — 50 100 150 200

Initial / Remold

Shear Strength (FV) kPa — 50 100 150 200

WP WL

Water Content (%) — 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

native cave

At drilling completion, dry cave at 2.74 m.

Vertical Scale = 1 : 50.0

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

Z:\Style_LVM_OntarioLog Borehole_Log_LVM_Ontario.sty - Printed : 2018-01-29 13 h

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *237.91 m*

Borehole Number: **BH-10-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		237.91			
	FILL: compact brown sand and gravel, trace silt		0.00			
	wet		237.15 / 0.76	SS-1	5-16 15	31
	very dense		236.39 / 1.52	SS-2	9-24 28	52
	SAND AND GRAVEL: dense brown sand and gravel, trace silt, moist		235.93 / 1.98	SS-3	4-18 23	41
	SILT TILL: very dense sandy silt, some gravel, moist		234.86 / 3.05	SS-4	17-40 38	78
				SS-5	9-45 40	85
	Borehole terminated at 5.03 m.		232.88 / 5.03			

Dynamic Cone: 20 40 60 80

Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200

Initial / Remold

Shear Strength (FV) kPa: 50 100 150 200

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

native cave

At drilling completion, dry cave at 3.35 m.

Vertical Scale = 1 : 50.0

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

Englobe

Ground Elevation: *237.86 m*

Borehole Number: **BH-11-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		237.86			
	FILL: compact brown sand and gravel, some silt, moist		0.00			
				SS-1	7-11 13	24
			236.34			
	silty sand and gravel		1.52	SS-2	10-12 13	25
	Borehole terminated at 1.98 m.		235.88 1.98			

Dynamic Cone — Std Penetration — 20 40 60 80

Shear Strength (PP) kPa — Initial — Remold — Shear Strength (FV) kPa — 50 100 150 200

WP — WL — Water Content (%) — 10 20 30

Groundwater Observations and Standpipe Details

native backfill

At drilling completion, borehole open and dry.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *237.97 m*

Borehole Number: **BH-12-18**

Job N°: *P-0015102-0-01-100*

Drill Date: *2018-01-04*

Project: *Brant County SPCA and City of Brantford Pound*

Field Tech: *T. Staples*

Location: *Kraemers Way, Brantford, Ontario*

Drill Method: *Hollow Stem Augers*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		237.97			
	FILL: dense brown sand and gravel, wet		0.00 / 237.21			
1	wet		0.76 / 236.45	SS-1	11-22 20	42
2	compact brown silt, some sand, trace gravel, moist		1.52 / 235.68	SS-2	11-12 13	25
3	***SAND AND GRAVEL:*** dense brown sand and gravel, trace silt, moist		2.29 / 234.92	SS-3	12-16 24	40
4	***SAND:*** dense brown sand, trace silt, damp		3.05 / 233.40	SS-4	18-22 20	42
5	***SAND AND GRAVEL:*** dense brown sand and gravel, some silt, moist		4.57 / 232.94	SS-5	16-22 24	46
	Borehole terminated at 5.03 m.		5.03			

Dynamic Cone: 20 40 60 80
Std Penetration: 20 40 60 80
Shear Strength (PP) kPa: 50 100 150 200
Initial
Remold
Shear Strength (FV) kPa: 50 100 150 200
WP WL
Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill
bentonite seal
native cave
At drilling completion, dry cave at 3.35 m.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes:

Z:\Style_LVM_OntarioLog Borehole_Log_LVM_Ontario.sty - Printed : 2018-01-29 13 h

Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Naylor Engineering Associates Ltd.
CONSULTING ENGINEERS

Borehole Number: 101

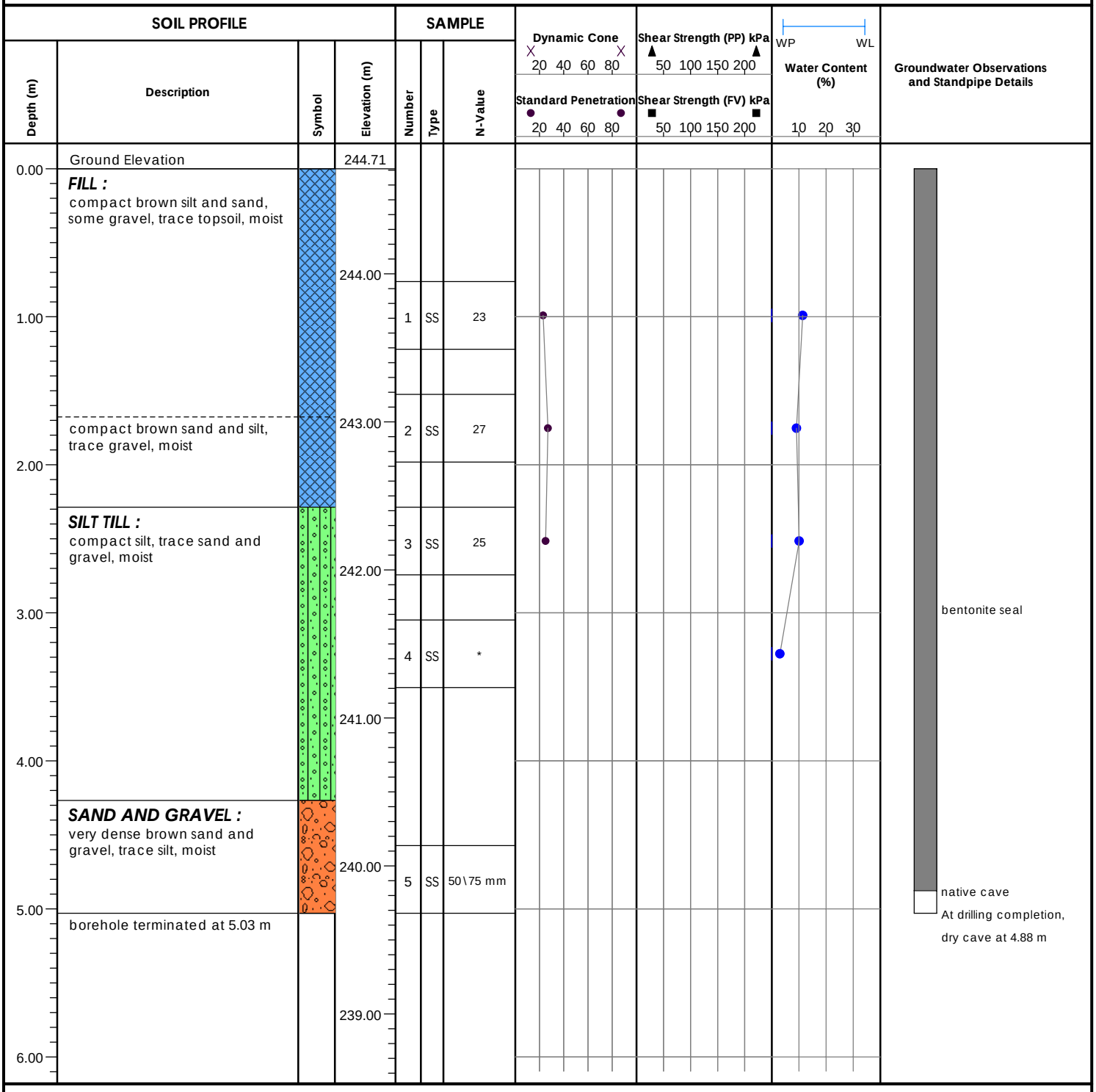
Ground Elevation: ***244.71 m***

Project: ***Geotechnical Investigation, Proposed Development***

Job No.: ***2860G12***

Location: ***Lot 22, Kraemer's Way, Brantford, Ontario***

Drill Date: ***December 20, 2006***



Reviewed by: ***TS***

Drill Method: ***Solid Stem Auger***

Notes: **** Sampler bouncing on gravel.***

Field Tech.: ***DB***

Sheet: ***1 of 1***

Drafted by: ***LR (01a)***

Naylor Engineering Associates Ltd.
CONSULTING ENGINEERS

Borehole Number: 102

Ground Elevation: ***243.57 m***

Project: ***Geotechnical Investigation, Proposed Development***

Job No.: ***2860G12***

Location: ***Lot 22, Kraemer's Way, Brantford, Ontario***

Drill Date: ***December 20, 2006***

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		243.57			
	FILL : compact brown sand and silt, some gravel, moist		243.00			
1.00				1	SS	20
			242.00	2	SS	20
2.00	***SILT TILL :*** compact brown sand and silt, trace gravel, moist					
	dense		241.00	3	SS	40
3.00	***SAND AND GRAVEL :*** very dense brown sand and gravel, some silt, moist			4	AS	50\125 mm
	borehole terminated at 3.51 m		240.00			
4.00			239.00			
5.00			238.00			
6.00						

Dynamic Cone / Standard Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: bentonite seal; native cave

At drilling completion, dry cave at 3.35 m

Reviewed by: ***TS***

Drill Method: ***Solid Stem Auger***

Notes:

Field Tech.: ***DB***

Sheet: ***1 of 1***

Drafted by: ***LR (01a)***

Naylor Engineering Associates Ltd.
CONSULTING ENGINEERS

Borehole Number: 103

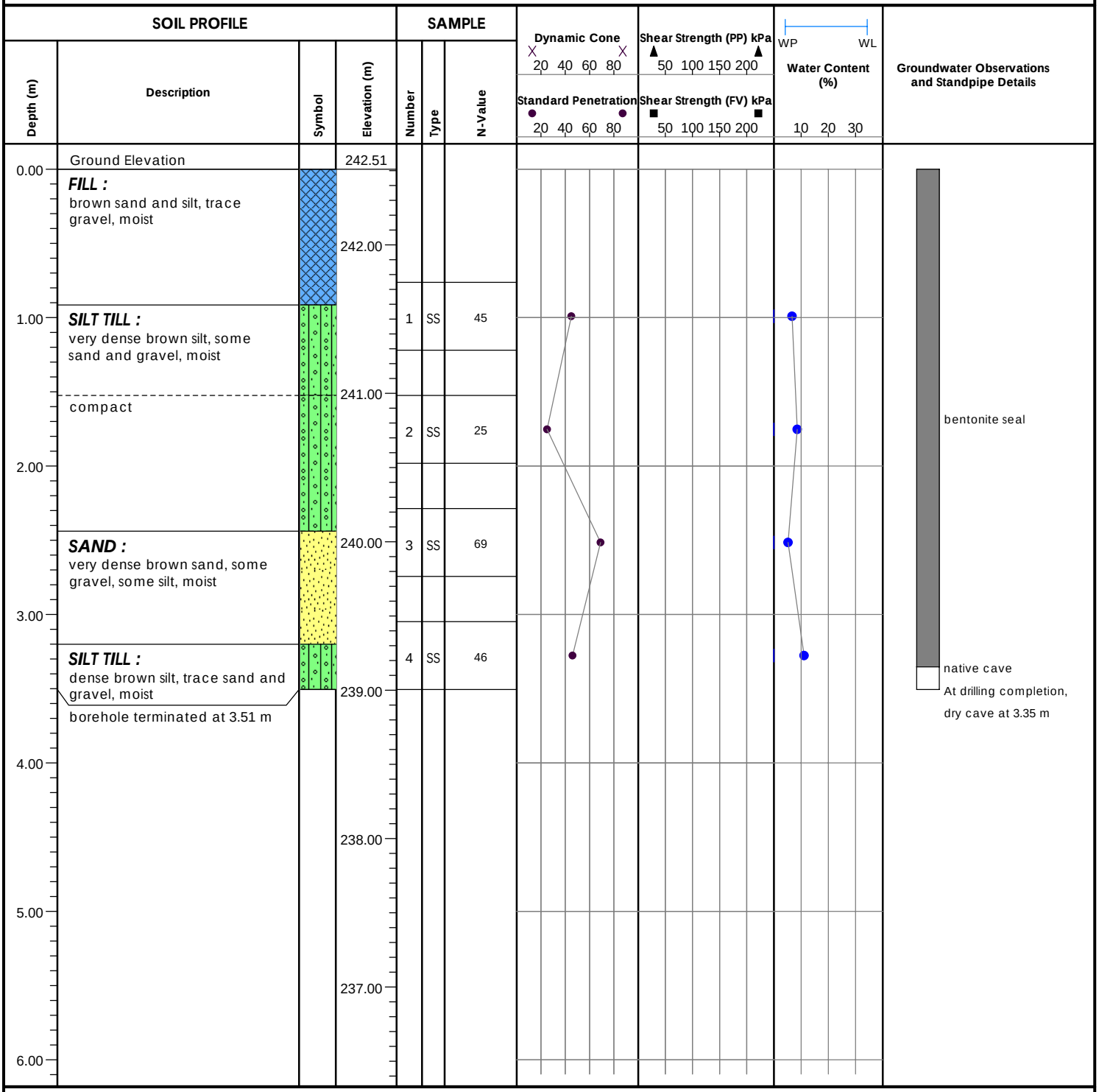
Ground Elevation: ***242.51 m***

Project: ***Geotechnical Investigation, Proposed Development***

Job No.: ***2860G12***

Location: ***Lot 22, Kraemer's Way, Brantford, Ontario***

Drill Date: ***December 20, 2006***



Reviewed by: ***TS***

Drill Method: ***Solid Stem Auger***

Notes:

Field Tech.: ***DB***

Sheet: ***1 of 1***

Drafted by: ***LR (01a)***

Naylor Engineering Associates Ltd.
CONSULTING ENGINEERS

Borehole Number: 104

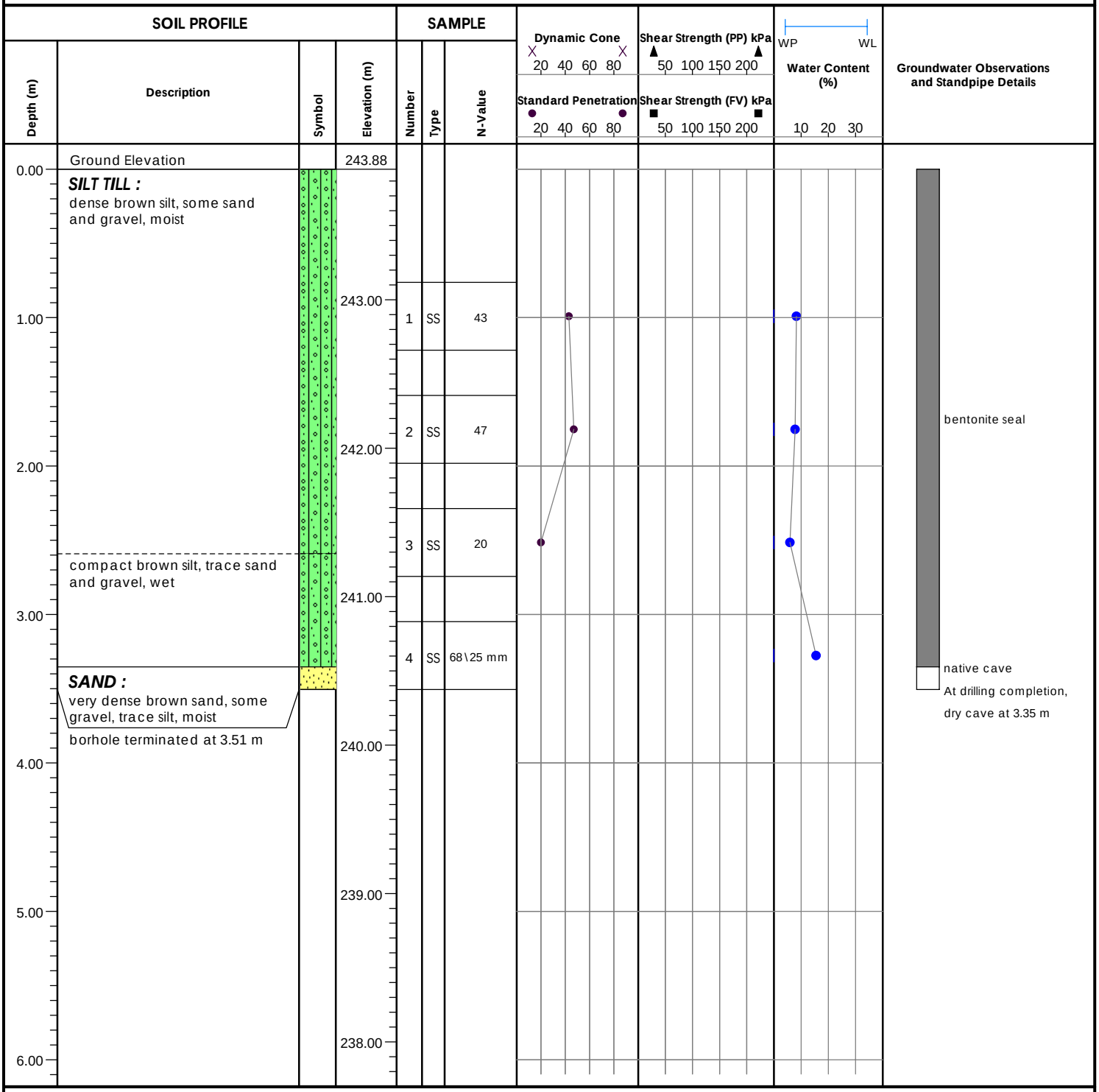
Ground Elevation: ***243.88 m***

Project: ***Geotechnical Investigation, Proposed Development***

Job No.: ***2860G12***

Location: ***Lot 22, Kraemer's Way, Brantford, Ontario***

Drill Date: ***December 20, 2006***



Reviewed by: ***TS***

Drill Method: ***Solid Stem Auger***

Notes:

Field Tech.: ***DB***

Sheet: ***1 of 1***

Drafted by: ***LR (01a)***

Naylor Engineering Associates Ltd.
CONSULTING ENGINEERS

Borehole Number: 105

Ground Elevation: ***243.29 m***

Project: ***Geotechnical Investigation, Proposed Development***

Job No.: ***2860G12***

Location: ***Lot 22, Kraemer's Way, Brantford Ontario***

Drill Date: ***December 20, 2006***

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		243.29			
	SAND : very dense brown silty sand, some gravel, moist		243.00	1	SS	50\125 mm
1.00						
			242.00	2	SS	24
	compact brown sand, some gravel, trace silt, damp					
2.00			241.00	3	SS	31
	SILT : dense brown silt, trace sand, wet					
	SAND : dense brown sand, trace silt, moist					
3.00	very dense, some silt, wet		240.00	4	SS	51
	borehole terminated at 3.51 m					
4.00			239.00			
5.00			238.00			
6.00						

Dynamic Cone / Standard Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: bentonite seal; native cave; At drilling completion, dry cave at 3.35 m

Reviewed by: ***TS***

Drill Method: ***Solid Stem Auger***

Notes:

Field Tech.: ***DB***

Sheet: ***1 of 1***

Drafted by: ***LR (01a)***

Naylor Engineering Associates Ltd.
CONSULTING ENGINEERS

Borehole Number: 106

Ground Elevation: ***238.31 m***

Project: ***Geotechnical Investigation, Proposed Development***

Job No.: ***2860G12***

Location: ***Lot 22, Kraemer's Way, Brantford, Ontario***

Drill Date: ***December 20, 2006***

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		238.31			
	SAND : brown sand, some silt, damp		238.00			
1.00	***SILT TILL :*** very dense brown silt, some sand and gravel, moist		237.00	1	SS	50\125 mm
				2	SS	50\125 mm
2.00	borehole terminated at 1.98 m		236.00			
3.00			235.00			
4.00			234.00			
5.00			233.00			
6.00						

Dynamic Cone / Standard Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200

Water Content (%): WP WL; 10 20 30

Groundwater Observations and Standpipe Details: bentonite seal; native cave; At drilling completion, dry cave at 1.83 m

Reviewed by: ***TS***

Drill Method: ***Solid Stem Auger***

Notes:

Field Tech.: ***DB***

Sheet: ***1 of 1***

Drafted by: ***LR (01a)***

Naylor Engineering Associates Ltd.
CONSULTING ENGINEERS

Borehole Number: 107

Ground Elevation: ***238.78 m***

Project: ***Geotechnical Investigation, Proposed Development***

Job No.: ***2860G12***

Location: ***Lot 22, Kraemer's Way, Brantford, Ontario***

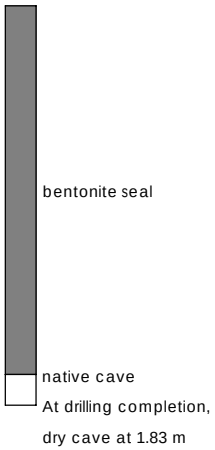
Drill Date: ***December 20, 2006***

Depth (m)	Description	Symbol	Elevation (m)	Sample Number	Sample Type	N-Value
0.00	Ground Elevation		238.78			
	SAND : compact brown sand, some silt, trace gravel, damp			1	SS	18
1.00	trace silt					
	very dense		237.00	2	SS	62
2.00	borehole terminated at 1.98 m					
3.00			236.00			
4.00			235.00			
5.00			234.00			
6.00			233.00			

Dynamic Cone / Standard Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200

Water Content (%): WP WL; 10 20 30



Reviewed by: ***TS***

Drill Method: ***Solid Stem Auger***

Notes:

Field Tech.: ***DB***

Sheet: ***1 of 1***

Drafted by: ***LR (01a)***

Appendix C Laboratory Test Results

Figures 1: Particle Size Distribution Analyses

Englobe

PARTICLE SIZE ANALYSES

Project: **Brant County SPCA and City of Brantford Pound**

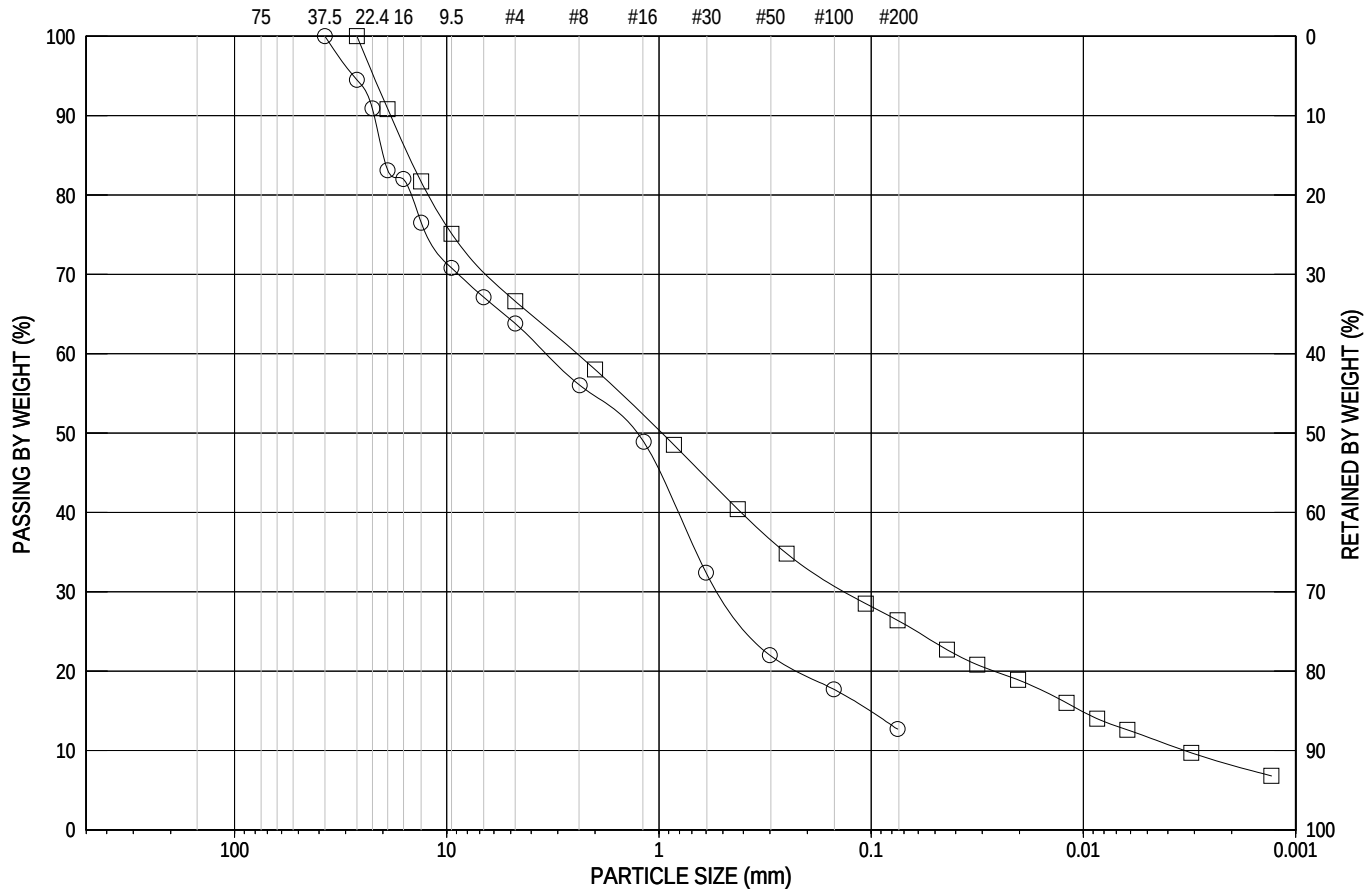
Figure No : **1**

Location: **Kraemers Way, Brantford, Ontario**

File No : **P-0015102-0-01-100**

UNIFIED SOIL CLASSIFICATION

COBBLES	*GRAVEL*		*SAND*			*SILT OR CLAY*
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN MILLIMETRES			*U.S. STANDARD SIEVE No.*			*HYDROMETER*



Symbol	Borehole n°	Sample n°	Depth (m)	Description
—○—	BH-04-18	SS-3	2.29 - 2.74	Gravelly SAND, some Silt
—□—	BH-12-18	SS-5	4.57 - 5.03	SAND AND GRAVEL, some Silt, trace Clay

2024-113 - General Contractor for Animal Shelter Construction

Opening Date: October 3, 2024 8:30 AM

Closing Date: October 31, 2024 3:00 PM

Bid Number: 2024-113

Schedule of Prices

Instructions on How to Complete Pricing Form
(a) Rates shall be provided in Canadian funds, inclusive of all applicable duties and taxes except for HST.

(b) Rates quoted by the bidder shall be all-inclusive and shall include all labour and material costs, all travel and disbursement costs, all insurance costs, and all other overhead, including any fees or other charges required by law.

The Summary Table provides your Sub-Total for each pricing table and also indicates whether or not the table is mandatory. Asterisks within the table denote a "**MANDATORY**" line item.

If the line item and/or table is "**NON-MANDATORY**" and you are not bidding on it, leave the table and/or line item blank. Do not enter a $0.00 dollar value unless you are prepared to provide the line item at zero dollars to the City.

If a table is "**NON-MANDATORY**" and you are bidding on it, you must bid on all line items with an asterisk.

If there are multiple tables, you must click the "**EDIT PRICING**" button inside the Summary Table to display the applicable Pricing Table that you wish to bid on.

Pricing Form - Base Bid

The bidder having the lowest contract amount will be recommended for the award of the project.

Line Item	Description	Unit of Measure	Estimated Quantity	Unit Price *	Extended Price
1	Division 1 - General Requirements	lump sum	1		
2	Division 2 - Demolition	lump sum	1		
3	Division 3 - Concrete	lump sum	1		
4	Division 4 - Masonry	lump sum	1		
5	Division 5 - Metals	lump sum	1		
6	Division 6 - Wood, Plastics and Composites	lump sum	1		
7	Division 7 - Thermal and Moisture Protection	lump sum	1		
8	Division 8 - Openings	lump sum	1		
9	Division 9 - Finishes	lump sum	1		
10	Division 10 - Specialities	lump sum	1		
11	Division 12 - Furnishings	lump sum	1		
12	Division 20 - Common Mechanical Equipment	lump sum	1		
13	Division 21- Fire Suppression	lump sum	1		
14	Division 22 - Plumbing	lump sum	1		
15	Division 23 - Heating, Ventilating and Air Conditioning (HVAC)	lump sum	1		
16	Division 25 - Integrated Automation	lump sum	1		
17	Division 26 - Electrical	lump sum	1		
18	Division 27 - Communications	lump sum	1		
19	Division 31 - Earthwork	lump sum	1		
20	Division 32 - Exterior Improvements	lump sum	1		
				Subtotal:	

Provisional Items

The total contract amount shall include a price for the provisional item(s) as identified in the Pricing Form. The City reserves the right to delete any or all provisional items from the lowest bidder's contract amount should it be determined by the City that the work is not required or not within project budget.

Line Item	Description	Unit of Measure	Quantity	Unit Price *	Extended Price
1	Paw Print Signage on Exterior	lump sum	1		
2	Landscape Planting: 27 Privacy Shrubs around fencing - ToE/27 as per drawing L100	lump sum	1		
				Subtotal:	

Cash Allowance

All of the bidder's costs relating to cash allowance items, other than the actual purchase, should be included in the total contract amount, not in the allowance. Expenditure of the cash allowance shall be authorized by the Project Manager.

Description	Unit of Measure	Quantity	Unit Price	Extended Price
Material Testing & Inspections Allowance	lump sum	1	$40,000.0000	$ 40,000.0000
			Subtotal:	$ 40,000.0000

Separate Items

The City reserves the right to add any or all separate price items to the lowest bidder's contract amount should it be determined by the City that the work is required and within project budget.

Line Item	Description	Unit of Measure	Quantity	Unit Price *	Extended Price
1	Upgrade to Turf in Dog Run – as per division 31 92 00	lump sum	1		
2	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Small Pet Intake Room 106	lump sum	1		
3	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Cat Adoption Room 107	lump sum	1		
4	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Cat Group Adoption Room 108	lump sum	1		
5	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Dog Meet and Greet Room 109	lump sum	1		
6	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Food Prep Room 111	lump sum	1		
7	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Dog Adoption Room 112	lump sum	1		
8	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Cat Intake Room 125	lump sum	1		
9	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Cat Nursing - Room 126	lump sum	1		
10	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Cat Isolation Room 128	lump sum	1		
11	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Dog Intake Room 135	lump sum	1		
12	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Dog Isolation Room 136	lump sum	1		
13	Upgrade to Epoxy flooring (instead of sheet vinyl) as per drawings A701 & A702 and specifications - Exam Room 137	lump sum	1		
				Subtotal:	

Additional Unit Rates

Unit prices for additional work shall include all mark-ups and overhead.

Additional work must be authorized in writing by the City prior to commencement. Where the rates for additional work are unreasonably priced or do not represent the true market cost for that item, the City reserves the right to negotiate with the bidder a more acceptable and representative price.

Description	Unit of Measure	Unit Price *
Labourer - General	hour	
Labourer - Demolition	hour	
Labourer - Concrete	hour	
Labourer - Masonry	hour	
Labourer - Framing	hour	
Labourer - Carpentry	hour	
Labourer - Roofing	hour	
Labourer - Drywaller	hour	
Labourer - Flooring	hour	
Labourer - Painter	hour	
Labourer - HVAC	hour	
Labourer - Plumber	hour	
Labourer - Electrician	hour	
Labourer - Equipment Operator	hour	
Labourer - Landscaping	hour	

Summary Table

Bid Form	Amount
Pricing Form - Base Bid	
Provisional Items	
Cash Allowance	$ 40,000.0000
Subtotal Contract Amount:	

The bidder confirms that the pricing information provided is accurate. The bidder acknowledges that any inaccurate, misleading or incomplete information, including withdrawn or altered pricing, could adversely impact the acceptance of its bid or its eligibility for future work.

References

Provide current references, not to include the City of Brantford, for work of a similar nature (i.e. size and scope) to this project. The City of Brantford may verify references and a negative or poor reference or job completion may, at the City's sole discretion, be sufficient reasons for not negotiating a contract with the bidder.

References

Business Name	Description of Project/Work	Date Work Completed	Project Value	Reference Contact Name & Number	Email Address	
						*
						*
						*

Subcontractors

The bidder shall state all Subcontractor(s) and type of work proposed to be used for this project. 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.

The bidder shall **state only one (1) Subcontractor for each type of work.**

Subcontractors

☐ By clicking here I confirm that there are no Subcontractor(s) and the bidder shall perform the project with their "**OWN FORCES**".

Trade	Business Name & Address	Contact Name & Number	
			*

Addenda, Terms and Conditions

Submission Form

1. Acknowledgement of Terms of Reference and Governing Law

The bidder acknowledges that this competitive process will be governed by the terms and conditions of the competitive document.

2. Ability to Provide Deliverables

The bidder has carefully examined this competitive document and has a clear and comprehensive knowledge of the Deliverables required. The bidder represents and warrants its ability to provide the Deliverables in accordance with the requirements of the competitive document for the rates set out in the completed Pricing Form

3. Prohibited Conduct

The bidder declares that it has not engaged in any conduct prohibited by this competitive process.

4. Confidential Information of Bidder

A bidder should identify any confidential information in its response or any accompanying documentation. The City will make reasonable efforts to safeguard confidential information of bidders, subject to its disclosure requirements under the Municipal Freedom of Information and Protection of Privacy Act or any other disclosure requirements imposed by order of a court or tribunal. The bidder agrees that their bid will, as necessary, be disclosed on a confidential basis to the City's advisers retained to advise or assist with this competitive process, including the review of bids. In addition, the bidder consents to the disclosure of contractual information, including pricing information, which may be disclosed to City Council and, accordingly, may become part of the public record. If a bidder has any questions about the collection and use of information pursuant to this competitive document, questions are to be submitted to the Purchasing Contact.

☐

I/WE agree to be bound by the terms and conditions contained in the bid document and any applicable Addenda, and the person named below has the authority to submit this bid on behalf of the bidder.

Conflict of Interest

For the purposes of this section, the term "Conflict of Interest" includes, but is not limited to, any situation or circumstance where:

(a) in relation to the bidding process, the bidder has an unfair advantage or engages in conduct, directly or indirectly, that may give it an unfair advantage, including but not limited to (i) having, or having access to, confidential information of the City in the preparation of its bid that is not available to other bidders; (ii) communicating with any person with a view to influencing preferred treatment in the competitive bidding process (including but not limited to the lobbying of decision makers involved in the competitive process); or (iii) engaging in conduct that compromises, or could be seen to compromise, the integrity of the open and competitive process or render that process non-competitive or unfair; or

(b) in relation to the performance of its contractual obligations under a contract for the Deliverables, the bidder's other commitments, relationships or financial interests (i) could, or could be seen to, exercise an improper influence over the objective, unbiased and impartial exercise of its independent judgement, or (ii) could, or could be seen to, compromise, impair or be incompatible with the effective performance of its contractual obligations.

Bidders must declare all potential Conflicts of Interests which includes disclosing the names and all pertinent details of all individuals (employees, advisers, or individuals acting in any other capacity) who (a) participated in the preparation of the bid; AND (b) were employees of the City within twelve (12) months prior to the Submission Deadline.

If you declare a Conflict of Interest select 'YES' and provide the required details. If no Conflict of Interest exists select 'NO'.

○ **Yes** ○ **No**

Addenda

The bidder is deemed to have read and accepted all addenda issued by the City prior to the Submission Deadline. The onus is on bidders to make any necessary amendments to their bids based on the addenda.

Please check the box in the column "**I have reviewed this addendum"** below to acknowledge each of the addenda.

File Name	I have reviewed the below addendum and attachments (if applicable)	Pages
There have not been any addenda issued for this bid.		