



S P E C I F I C A T I O N S

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+VG Project No. 22530

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August 2026

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END OF SECTION

TENDERS

1. TENDER TIME-TABLE

Tender Issue	August 18, 2026
Mandatory Bidders Site Meeting	August 21, 2026, 1:00:00 p.m.
Deadline for Questions	Sept. 2, 2026, 4:00:00 p.m.
Tender Form Closing	Sept. 7, 2026, 1:00:00 p.m.
Supplementary Tender Form Closing	Sept. 7, 2026, 4:00:00 p.m.

NOTE: All general contractors who are considering submitting a tender proposal MUST attend the mandatory site visit. Any proponent that submits a proposal and has not attended the site visit will automatically be disqualified and their proposal will be classified as non-compliant.

2. ELECTRONIC TENDERING SYSTEM:

1. All Bidders shall have a Bidding System Vendor account and be registered as a Plan Taker for this Bid opportunity on Biddingo (Bidding System). A link will also be provided on the Town of Hanover website: www.hanover.ca.
- .2 To ensure receipt of the latest information and updates regarding the bid or if a Bidder has obtained this Bid Document from a third party, the onus is on the Bidder to create a Bidding System Vendor account and register as a Plan Taker for the bid opportunity at: biddingo.com.
- .3 Biddingo (Bidding System) will be used only for the Owner's posting of tender documents and addenda.
- .4 Should the Bidder require technical assistance in the use of the Bidding System, please contact www.biddingo.com directly.

3. BID CLOSING DATE AND TIME:

- .1 **ELECTRONIC BID SUBMISSIONS ONLY, tender forms** shall be received by the Owner, **before 1:00:00 p.m. Eastern local time, on September 7, 2026.** **Supplementary Tender Form** shall be received by the Owner before **4:00:00 p.m. Eastern local time on September 7, 2026.**

Electronic bid submissions shall be sent directly to; Vicki McDonald
civic@hanover.ca.

- .2 The closing time shall be determined by the Owner's clock.
- .3 Proponents are cautioned that the timing of their Bid Submission is based on when the Bid is **RECEIVED, not** when a bid is submitted by a Proponent, as bid transmission can be delayed in an **"Internet Traffic Jam"** due to file transfer size, transmission speed and other electronic or cyber issues.
- .4 For the above reasons, the Owner recommends that Proponents allow sufficient time to upload their Bid Submission and attachment(s) (if

applicable) and to resolve any issues that may arise. The closing time and date shall be determined by the Owner's clock.

- .5 All Bids shall be irrevocable and shall remain open for acceptance, at the prices quoted, for up to sixty (60) business days from the Bid Submission Deadline. In submitting a Bid, each Proponent agrees that, notwithstanding anything to the contrary, the Owner may notify the Successful Proponent at any time within the Bid validity period that its Bid has been awarded.
- .6 Late Proposals shall not be accepted by the Owner's Bidding System and the Owner will not be held liable or accept any responsibility for any bids that can be successfully uploaded by a Proponent.

4. BID SUBMISSIONS

- .1 Complete electronic bid submissions shall include:
 - .1 Complete Tender Form and Supplementary Tender Form, signed, sealed and dated; and
 - .2 Bid Bond; and
 - .3 Consent of Surety/Agreement to Bond; and
 - .4 Proof of Insurance as noted in this Section; and
 - .5 WSIB Certificate of good standing.
 - .6 CCDC Document 11
- .2 Tenders must be submitted on the Tender Form and Supplementary Tender Form issued with Tender Documents.
- .3 All blanks on Tender Form and Supplementary Tender Form must be filled in. Failure of a Bidder to insert a value for any Value or Unit Price shall be deemed to be a "zero dollar" (\$0) value.
- .4 Tenders shall not be qualified by any condition without express written consent of the Consultant clarified by an Addendum only prior to submission of Tender.
- .5 All requirements of the Tender Form and Supplementary Tender Form must be completed.
- .6 Bidders shall be solely responsible for delivery of Tender in the manner and time prescribed.
- .7 Bidders shall be solely responsible for verifying they have received all of the Addenda issued.

5. WITHDRAWAL/AMENDMENT OF SUBMISSION

- .1 Bidders may amend or withdraw their submission prior to the closing time and date. However, it is the Bidders responsibility to:
 - .1 Withdrawal - Ensure the submission is **withdrawn** before the time of closing, on the bid closing date;
 - .2 Amendment – Ensure the re-submitted bid is **received** by the Owner before the time of closing, on the bid closing date.

6. INFORMAL OR UNBALANCED TENDERS

1. Tenders which are incomplete, conditional, illegible or obscure, or that contain reservations, erasures, alterations, or irregularities of any kind may be rejected as informal.

7. INQUIRIES, OMISSIONS, DISCREPANCIES AND INTERPRETATIONS

- .1 All tender documents are complimentary and must be read together to ascertain a complete description of the Work.
- .2 Examine Tender Documents for completeness, discrepancies or omissions. Should a Bidder find omissions or discrepancies in any part of this Tender or should the Bidder be in doubt as to the meaning of any part of such documents, notify the Owner's designee of discrepancies or omissions as noted in .3 below.
- .3 All **Inquiries** concerning this Tender including specifications, process and results are to be directed in writing via email to: **Andrew Wilken** awilken@hanover.ca only. Do not submit questions through Biddingo.

Questions and answers will be shared with all Bidders in the form of an addendum. Questions must be submitted no later than the date and time indicated in the Tender Time-Table at the beginning of this section.

- .4 No inquiries will be accepted by telephone. Inquiries made by telephone, fax, or verbally will not be accepted or answered and will not form a part of the tender documents.
- .5 The Owner and Architect shall not be held liable for any errors or omissions in any part of this Tender. While the Owner and Architect have used considerable efforts to ensure an accurate representation of information in this document, the information contained herein is supplied solely as a guideline for Bidders. The information is not guaranteed or warranted to be accurate by the Owner and Architect, nor is it necessarily comprehensive or exhaustive. Nothing in the document is intended to relieve the Bidder from forming their own opinions and conclusions with respect to the matters addressed in this Call for Bid document.
- .6 The Owner and Consultants shall not be bound by any verbal instruction, amendment, clarification, informative advice or suggestion from any of the Owner's personnel, Trustees or agents or consultants to the Owner. Communication with interested proponents is to be solely through the Owner's Bidding System.
- .7 Provide notification at once of discrepancies found in, or omissions from the drawings, specifications or other documents or if in doubt as to their meaning; A written instruction through an Addendum will be sent to all

Bidders. If a discrepancy exists, an addendum will be issued to all Bidders to clarify or correct such discrepancies.

- .8 Neither Owner, Consultants nor Architect will be responsible for any verbal instructions.
- .9 Should any discrepancies or omissions go unreported during tendering period, the proper interpretation of the bid documents shall be at the discretion of the Architect.

8. ADDENDA

- .1 Addenda may be issued during the Tender period. All addenda will be issued on the The Bidding System platform.
- .2 To ensure receipt of the latest information, updates, clarifications and/or addenda via email from The Bidding System regarding this Tender, or if a proponent has obtained this Tender from a third party, proponents "must" create a bidding system Vendor account with The Bidding System, and be registered as a "Plans Taker" with The Bidding System for this Tender. Addenda issued pursuant to this Tender will only be sent to those proponents who have properly registered with The Bidding System.
- .3 All addenda become part of the Tender Documents. Include costs arising from addenda in the Base Bid and Supplementary Tender Form. Confirm the completeness of all addenda.
- .4 Proponents shall acknowledge receipt of any addenda when submitting their bid through the Bidding System. Proponents shall check a box for each addendum / addenda and any applicable attachments that have been issued before a Proponent can submit their Bid Submission online.
- .5 Addendum/Addenda will be issued through the Bidding System, typically no less than forty-eight (48) Hours prior to Bid Closing Time and Date.
- .6 In the event an addendum is issued within forty-eight (48) Hours prior to Closing Time and Date, the Owner may include an extension of the Closing Time and Date. It is the responsibility of the Proponent to have received all Addenda that have been issued. Proponents should check online at www.biddingo.com prior to submitting their Bid and up until Bid closing time and date in the event additional addenda are issued.
- .7 The Owner encourages Bidders to not submit their Bid forty-eight (48) hours prior to the Bid Closing Time and Date, in the event that an addendum is issued. If a Bidder submits their bid prior to this or at any time prior to the bid closing and an addendum/addenda is issued by the Owner, the bid will be considered incomplete.
The Bidder is solely responsible to:

- .1 make any required adjustments to their Bid; and
- .2 acknowledge the addendum/addenda; and
- .3 ensure the re-submitted Bid is RECEIVED by the Owner before the specified Bid Closing, Time and Date.

9. TENDERING COSTS

- .1 All costs associated with the preparation and delivery of a tender shall be paid by the Bidder.
- .2 The Owner is not responsible for compensation of tendering costs under any circumstances.

10. AWARD OF CONTRACT

1. FACTORS AFFECTING CONTRACT AWARD

A Bidder's experience in this type of work, past performance, organization, proposed subcontractors, equipment, ability to perform and complete this Contract in the manner and within the time specified, together with the amount of the Tender, will be vital elements considered in the award of the Contract.

Only bids received from general contractors who have successfully completed new construction of similar scope on Police projects or similar use in the past 7 years will be considered. Projects of this description shall be clearly indicated in the CCDC Document 11 requested to be submitted.

- 1. The Owner reserves the sole discretionary right to accept or reject any or all bids received.
- 2. The Owner will evaluate the bids received and identify the offer which represents "best value", as interpreted in its own best interest by the Owner in its sole and absolute discretion; this may not be the lowest priced tender.
- 3. The owner will consider the following additional criteria in determining which, if any, offer to accept:
 - .1 General Contractor's CCDC Document 11- This required document will be used to evaluate the bidder's Relevant experience, Past Performance, References and other key elements.

The Owner reserves the right to award the contract based on the base bid price only or any combination of base bid, alternate prices, separate prices, and relevant experience which are deemed to be to the advantage of the Owner at the time of award at their sole discretion.

2. AWARD OR REJECTION OF TENDER

The Owner reserves the right to reject any or all tenders and to waive any irregularity therein the lowest tender may not necessarily be accepted.

3. ACCEPTANCE OF TENDER

No Bidder shall be considered under Contract after the opening and reading of Tenders until the AGREEMENT is signed and compliance therewith has been made.

4. DISPOSITION OF BONDS

Within seven days of opening of the tender, all bid bonds other than the securities from the two proponents deemed to offer "Best Value" shall be returned to the applicable bidders.

11. DELETION OF WORK UNDER THE CONTRACT

1. WORK DELETED FROM THE CONTRACT

The Owner reserves the right to delete any or all work from the contract.

The contract amount will be the tender amount plus or minus the amounts of separate and alternate prices accepted to as determined by the owner and Architect.

12. BID BOND

1. Every tender shall be accompanied by a Bid Bond (with a recognized Guarantee or Insuring company - approved by the Canadian Construction Association) in the amount of 10% of the Tender Sum being quoted which may be forfeited. The tenderer agrees that, if they withdraw this tender within 60 days after the closing date, the deposit made with this tender shall be forfeited to the Owner.

13. BONDS

1. PERFORMANCE BOND

An Agreement to Bond for **50%** of the Tender amount must accompany each tender and the tenderers shall include for the cost to provide a **50%** Performance Bond in their Tender Amount. Refer to CCDC Document 2 (Revised 2020). The format must conform to CCDC Document 2 (Revised 2020) General Conditions and as amended in the Supplementary General Conditions. The issuing company of the Bond must be approved by the Canadian Construction Association.

NOTE: At Substantial Performance of the contract, this bond shall be converted to cover the warranty period and shall remain in force for a period of **24 months** after the date of substantial performance.

2. LABOUR AND MATERIAL BOND

An Agreement to Bond for **50%** of the Tender amount must accompany each Tender and the Tenderers shall include for the cost to provide a **50%** Labour and Material Bond in their Tender Amount. Refer to CCDC Document 2 (Revised 2020). The format must conform to CCDC Document 2 (Revised 2020) General Conditions and as amended in the Supplementary General Conditions. The issuing company of the Bond must be acceptable to the Owner and approved by the Canadian Construction Association.

3. Both Performance Bonds and Labour and Materials Bonds are to be provided within seven (7) days of award of tender, after receiving notification of acceptance of their quotation from the Owner or forfeit the amount of the Bid Bond enclosed with the tender.

14. CONTRACT

1. The successful bidder shall execute the said formal contract as called for, within 7 days after notification of the acceptance of their tender or forfeit the amount of the Bid Bond enclosed with the tender.
2. The successful bidder will be required to execute a "Canadian Standard Form of Construction Contract to a Stipulated Sum" (Revised 2020) CCDC Document No. 2, including Amendments thereto as set out in the Supplementary General Conditions.

15. SITE

1. The work is to be performed at 203, 10th Street, Hanover, Ontario.

16. CLIENT / OWNER

1. The Client is The Corporation of the Town of Hanover – 341, 10th Street, Hanover, ON N4N 1P5.

17. CONSULTANTS

1. The Architect is: +VG - The Ventin Group Ltd., Architects
50 Dalhousie Street
Brantford, Ontario N3T 2H8
2. The Structural Engineer is: Structures +VG.
50 Dalhousie Street
Brantford, Ontario N3T 2H8
3. The Mechanical/
Electrical Engineer is: Vanderwesten & Rutherford Associates Inc.
7242 Colonel Talbot Road,
London, ON Canada, N6L 1H8

4. Civil Engineer is: Cobide Engineering Inc.
517, 10th Street,
Hanover, ON N4N 1R4

18. DOCUMENTS

1. The Documents are listed in the front of the book/document which contains them and a list of drawings is incorporated in the specifications.
2. Drawings and specifications are the property of the Owner.
3. A pdf copy of the Bid documents will be placed with the Grand Valley and Orillia & Barrie Construction Associations.
4. Contractor to pay for all their own printing of documents for Tender and Bidding.

19. EXAMINATION

1. The site shall be accepted by the Contractor in its present condition. The Contractor will be held to have visited the site and to have carefully examined all conditions affecting the work to be done there on, including the location of all services which may have to be protected, removed or relocated. The Contractor shall accept sole responsibility for any error or neglect on their part in this respect. Submission of Tender shall be deemed confirmation that tenderer has inspected site and is thoroughly conversant with existing conditions. No claims for extra payment will be considered for extra work, expense or difficulties encountered due to conditions on each site which were visible upon or reasonably inferable from an examination of the said site prior to the closing of tenders.
2. Examine the specifications and drawings thoroughly. Report in writing through the Owner's Bidding System to Architect all ambiguities, discrepancies, omissions, errors, departures from Building Code, By-Laws, or from good practice, discovered during examination as early in the tender period as possible to allow clarification by addenda to be issued to all bidders. No claims for extra payment will be considered for work, expense or difficulties which are reasonably inferable from an examination of the documents prior to the closing of tenders.
3. The drawings and specifications complement each other and neither is to be considered alone. Hence, any item omitted in one, but mentioned or implied in the other, must be provided.
4. All changes to the contract documents which result in an extra or a credit to the contract amount are not to be executed until written instructions have been received and the extra or credit agreed to in writing by all parties to the contract.
5. The Contractor shall execute variations, alterations and substitutions which do not

affect the contract amount as instructed by the Architect or the Owner.

6. Bidders finding discrepancies or omissions in the drawings or specifications shall at once notify in writing through the Owner's Bidding System who shall send written instructions through an Addendum to all bidders. Bidders may, during the tender period, be advised by addenda of any additions, alterations or deletions to the specifications and drawings. All such changes shall be covered by the tender and become part of the contract documents.
7. If any person submitting a bid on this project is in doubt as to the true meaning and intent of any part of the specifications or other documents, they must submit a question on The Bidding System requesting an interpretation by the Architect. If such a question is not submitted and an interpretation is not requested, the bids will be presumed to be based on the interpretation or directions that may be subsequently given by the Architect after award of the Contract, in accordance with the provisions of the Contract.
8. Prior to the closing date of tenders, any and all necessary clarifications of the specifications or other Tender documents will be in the form of written Addenda. The Architect, Consultants and Owner will **NOT** be responsible for verbal instructions or explanations or interpretation of Drawings and Specifications.
9. No questions concerning this project will be accepted during the day of the tender closing date. The final date for questions to be submitted is noted above.

20. UNIT PRICES

- 1 At time of submission include in the tender form all the unit prices in accordance with the Supplementary Tender Form. These unit prices will be included in the agreement.
- 2 Unit prices shall include labour, material and applicable taxes , overhead and profit, and other relative charges, but shall be exclusive of HST. Any work done on the basis of unit prices shall be carried out generally in accordance with the specifications for similar work and shall be to the Architect's approval.
- 3 The Owner reserves the right to accept or reject any or all of the Unit Prices prior to entering in the construction contract. The owner reserves the right to negotiate these unit prices rejected or proposed and to renegotiate prices for any proposed changes.

21. BASE BID TENDERS

1. Materials and equipment are specifically described and named in this specification to establish a standard of materials and workmanship to which the tenderers shall strictly adhere. Where manufacturer's trade names are used, the first named or specified by catalogue numbers meets specifications in all respects regarding performance, quality of material and workmanship, and is acceptable

to the Architect.

2. Where the contractor uses equivalent products (either identified in the specifications or added after review by addendum) other than the first named, on which the design is based, they shall be responsible for all details of installation including product size, arrangement, fit, colour, etc. and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected surrounding equipment, etc. Failure by Contractor to provide such drawings may be considered indication that original arrangements, and space allocations are adequate. All additional costs associated with equivalent products such as revisions to surrounding architectural finishes, structural components, or the need for larger motor starters, larger power feeders, space revisions to associated product, equipment, controls, etc. shall be provided by the General Contractor and be included in Bid price.
3. Tenders may include with their lump sum tenders, alternative proposals based on the use of alternative material equivalent to the materials or equipment specified, in quality and performance, provided clearances and dimensions shown on the drawings are maintained. For all such alternative proposals, the tenderer shall include such proposals and the following information, in a letter accompanying their tender, for consideration by the Owner and Architect at the time of opening tenders. Under no circumstances shall the bid for an alternative material or equipment be included in the tender amount.
 1. Manufacturer's name and supplier's name.
 2. Change in price, if any.
 3. Reason for proposing alternative.
 4. Detailed description of alternative.
 5. Statement assuming full responsibility that any equipment shall not exceed the space requirement allocated on the drawings. This contractor shall be responsible for any additional installation cost resulting from the acceptance of a substitute piece of equipment or product.
4. Under no circumstances will alternatives submitted after the closing of tenders, be considered.
5. The Architect reserves the right to accept or reject proposed alternatives as the Architect sees fit, and also to claim for the Owner, the financial benefit of a substitution, if a substitute is accepted. A rejection by the Architect does not become obligated to give any reason for their action.

22. PROCEDURES AND SUPPLY OF CRITICAL MATERIALS

1. Submission of a tender shall constitute the Tenderer's agreement that they will commence work immediately upon award of the Contract, and that they will execute the same without interruption until completion, including the furnishing of all necessary supplies and equipment for winter operations. Contractor shall assure themselves before submitting a tender that they are in a position to furnish adequate supplies of all materials, critical or otherwise, at such times necessary to ensure immediate commencement of the work and continuous operation

without delays on the project. The Contractor shall include in their tender amount, sufficient sums for the purchase of critical materials from any source available. The contractor shall include in their bid any costs related to storage of materials delivered to the site prior to the work being ready for their installation. After award of the contract, the Owner will not grant increases to the tender amount to obtain critical materials at premium prices, nor will delays or interruption of the work be tolerated.

23. LAWS, CODES AND REGULATIONS

The tenderer is assumed to have made themselves familiar with and abide by the Federal National Authorities, Provincial, Municipal and local laws, rules and regulations which in any manner affect those engaged or employed in the work, or in any way affect the work, and no plea of misunderstanding will be considered on account of ignorance thereof. If the Bidder shall discover any provisions in the drawings, specifications or contract which are contrary to or inconsistent with any law, rule of regulation, Contractor shall at once report it in writing through Bids and Tenders.

24. PERMITS

1. The Owner will be applying and paying for Building Permit and the Contractor shall expedite receiving and picking it up from the Building Department. The Contractor shall be responsible for expediting, obtaining, paying for and picking up all other necessary permits, relative inspection fees, licences, notices, certificates of inspection, approval required to carry out work and provide the Owner with proof of same.
2. It is the responsibility of this Contractor to expedite and obtain the required building permit prior to commencing the work. Contractor must allow for time to obtain all required permits within the project completion schedule.
3. Proof of issue of Building Permit must be submitted before any progress payments can be released for the project.

25. STATUTORY HOLDBACK

1. A holdback of 10% of the contract price shall be held by the Owner for a period of 60 days after substantial performance and approval of the work as per specifications and pursuant to the requirements of the Construction Act, the holdback will be released after the expiration of 60-day lien waiting period, provided no liens are then registered. The date of advertisement in a construction trade publication shall commence the lien period.
2. At the end of 60 days waiting period, the Contractor will submit to the Owner and Architect, an invoice for the amount of the 10% holdback, at which time affidavits will be submitted to the Owner ensuring there are no liens against the job at that time.

26. INSURANCE

1. All Risk Property Insurance, including fire insurance, to be provided by the General Contractor and shall be in joint names of the Owner, Architect and Consultants.
2. The Contractor shall provide a minimum of \$10,000,000.00 Public Liability Insurance.
The Contractor shall indemnify and save harmless the Owner, The Ventin Group Ltd., Architects, their Consultants, and their officers and agents from all claims relating to labour, materials and equipment furnished for the work and to inventions, patents or patent rights used in doing the work. The Contractor shall be responsible for any and all damages or claims for damages or injuries or accidents done to or caused by them or their employees or relating to the prosecution of the works, or any of their operations or caused by reason of the existence or location or condition of any materials, plant or machinery used there on, or which may happen by reason thereof, or arising from any failure, neglect or omissions on their part, or on the part of any of their employees to do or perform any or all of the several acts or things required to be done by them under and by these conditions and covenants and agrees to hold the Owner, The Ventin Group Ltd., Architects and Consultants, harmless and indemnified for all such damages and claims for damages.
3. Automobile Liability Insurance and Contractor's Equipment Insurance and all other insurances shall be provided by the General Contractor and shall be in joint names of the Contractor, the Owner, the Architect, and Consultants.
4. Proof of Insurances and the named insured showing the Owner as an additional named insured for the project shall be submitted to the Owner upon execution of the Contract. Insurance Certificate shall provide that the insuring company will give 60 days' notice to the Owner of an intention to cancel.

27. WORKPLACE SAFETY AND INSURANCE

1. Submit proof of Workplace Safety and Insurance coverage. The contractor shall provide the owner with written documentation that all Workplace Safety and Insurance and Employment Insurance payments are up to date and in order.

28. IMPERIAL/METRIC DIMENSIONS

1. Where both imperial and metric dimensions are given in this specification, the metric dimensions apply for this project.

29. SITE ACCESS

1. Contractor to remove all debris from site daily.
2. Location of all trailers, storage container units, and construction fences by contractor shall be reviewed and approved by the Owner and Architect at a

preliminary site meeting prior to contractor moving on to site.

3. Parking for construction workers shall be on site.
4. Site access for construction to be confirmed at first site meeting.
5. Construction Site must be closed and locked after hours.

30. TAXES AND DUTIES

The Base Bid Price shall be exclusive of any value added taxes, i.e., HST.

1. The successful General Contractor will indicate on each application for payment **as a separate amount** the appropriate HST the Owner is legally obliged to pay.

31. CASH ALLOWANCES

1. The Contractor shall include in the contract the sum of all cash allowances specified in the specifications, which allowances shall be expended in whole or in part as the Architect shall direct, and the amount of the contract sum being adjusted accordingly. The contract sum shall include such sums for expenses and profit on account of such cash allowances as the Contractor and all subcontractors require.
2. In the event that the cost of work covered by a cash allowance shall be greater than or less than the cash allowance, the contract sum shall be adjusted accordingly, there shall be no adjustment in the contract sum for expenses and profit; it being understood and agreed that the contract sum includes the Contractor's and Subcontractor's expenses and profit for all cash allowances whether or not they are exceeded. The Sub-contractor shall submit to the General Contractor copies of all invoices and statements from the suppliers furnishing materials, equipment, etc. purchased under the cash allowances.

32. GENERAL NOTES TO CONTRACTOR

1. The contractor will be required to keep and maintain a set of as-built drawings for each project. These drawings will be used for no other purpose than recording the exact location of buried or covered services and all changes to the contract documents. The as-built drawings will be submitted to the Architect along with guarantees, maintenance data, extra supplies, etc. at the substantial performance of the contract.
2. The contractor will turn over to the Architect at the completion of the contract all project close out documents, material, etc. These documents, material, etc. including occupancy permit, will be accepted only with a transmittal and at no other time than when submitting a written request for substantial performance of the contract. For purposes of determining a value of this work it will be

considered as **\$10,000**. Note this amount is in addition to any values identified in the mechanical and electrical divisions.

3. Conform to the Ontario Building Code, CEC CSA C22, (latest Edition as currently amended) CAN3-B44, and CSA W59.1, where applicable, to the Canadian Code for Construction Safety, as currently amended, and to the Construction Safety Act, Ont. as currently amended, and to all other applicable codes and Building By-Laws hereinafter referred to as Codes; and to the requirements of the authorities having jurisdiction, including public utilities, referred to in the Contract Documents as the authorities.

33. ACCESS TO INFORMATION

1. All tenders, quotes and proposals are subject to the Municipal Freedom of Information and Protection of Privacy Act and will be disclosed where the Owner is required to do so for the purposes of complying with an Order of the Information and Privacy Commissioner.

34. WHMIS REQUIREMENTS

1. Contractors shall comply with WHMIS requirements in accordance with the Occupational Health and Safety Act (Ontario). Before commencement of work and during the full term of the Contract, the Contractor shall provide a list with current MSDS for all hazardous materials proposed for use on the Project. The Contractor shall label hazardous materials used and/or supplied on the Project in accordance with WHMIS requirements. The Contractor shall conform to the Environmental Protection Act for disposal and clean-up requirements. The Contractor shall obtain from the Owner, where applicable, a list and MSDS of hazardous materials that may be handled, stored or used by the Owner's employees and/or other contractors retained by the Owner at the location where work of this Contract will be performed. The Contractor shall ensure that those who handle and/or are exposed to, or are likely to handle or to be exposed to hazardous materials, are fully instructed and trained in accordance with WHMIS requirements.
2. Also refer to Section 01545 - Safety Requirements.

END OF SECTION

TENDER FORM

FOR THE

**NEW HANOVER POLICE SERVICE BUILDING
203, 10TH STREET
HANOVER, ONTARIO**

FOR THE

CORPORATION OF THE TOWN OF HANOVER

SUBMITTED BY: _____

DATE: _____

1. Having carefully examined the Drawings and Specifications, including all Addendum thereto, issued prior to this date and numbered ____ to ____ inclusive, and the General Conditions of the Contract as amended by the Supplementary General Conditions, and having examined and complied with the Instructions to Bidders as prepared by The Ventin Group Ltd., Architects for the new Hanover Police Service Building, Hanover, Ontario, we hereby offer to furnish all the materials, plant and labour necessary for the proper completion of the work set forth in the aforesaid Drawings, Specifications, General Conditions, and Addenda, including all prime costs, Allowances, Goods and Services, and all applicable Taxes in force at this date **but not including Harmonized Sales Tax** and any additional or deductible Allowances or taxes that have not been announced and that may be imposed subsequent to this date, which shall be payable by or to the Owner in accordance with the aforesaid documents for the sum of:

TOTAL BASE BID SUM AMOUNT:

\$ _____ **(not incl. HST)**
in lawful money of Canada

2. The above stipulated tender sum includes all necessary overtime or premium work that will be required to complete this project on schedule.
3. Provide the name of the construction publication which will be used to publish the Certificate of Substantial Performance:

The General Contractor shall notify their subtrades and suppliers of this publication.

4. We propose to use the following Mechanical and Electrical Subcontractors, included in the above Base Bid Stipulated Tender Sum:

1. Mechanical Contractor (including controls & sprinklers) - Division 15

Sub-Contractor's Base Tender Sum \$_____ (+ HST)

Mechanical Contractor's Name _____

2. Electrical Contractor - Division 16

Sub-Contractor's Base Tender Sum \$_____ (+ HST)

Electrical Contractor's Name _____

5. BID BOND

We enclose herewith, in the amount of 10% of the Tender Price, a Bid Bond in the form approved by the Canadian Construction Association. In the event of this tender being accepted within the time stated herein, and our failure to enter into a contract in the form hereinafter mentioned, for the amount of our tender, the said security, limited to the lesser of the face value or the security or the difference between this tender and the tender for which the contract is signed, may be forfeited in lieu of damages to which the Owner may be entitled by reason of our failure or refusal to enter into a contract.

6. AGREEMENT TO BOND

We enclose herewith an Agreement to Bond for a 50% Performance Bond and a 50% Labour and Material Payment Bond, all in the form approved by the Canadian Construction Association issued by same surety who has issued the Bid Bond.

We the undersigned agree that if I/we default in executing a Contract or providing the required performance security in accordance with the terms of the bid documents, the Owner shall have sustained liquidated damages in the amount equal to the difference between the amount of this bid and the amount for which the Owner legally contracts with another party to perform the Work. If the latter amount be in excess of the former up to the amount of the bid bond and such amount shall become the property of the Owner.

7. **ALL WORK MUST PROCEED IN A CONTINUOUS MANNER AND SHALL BE COMPLETED & READY FOR THE OWNER'S OCCUPANCY in _____ WEEKS FOLLOWING ISSUANCE OF A LETTER OF INTENT FROM THE OWNER.**

8. In submitting this tender, it is understood that revised tenders shall not be called if minor changes only are contemplated.

9. MARK-UP

1. The following mark-up shall apply to work added to the Contract.

1. General Contractor's and Subcontractor's overhead and profit.

Note: Overhead and profit mark-up shall include increased bonding, site supervision, additional permit fees and all office overhead, and travel expenses. The cost for these items shall not be added onto any cost for changes prior to mark-up. Refer to Supplementary General Conditions SGC 16.

General Contractors may charge mark-up of **10%** on their own work and only **5%** on their subcontractors work and are not allowed to treat their own forces as Subcontractors.

Subcontractors may charge a maximum of **5%** fee for their own work. Subcontractors shall charge only **5%** on extras for their subcontractors work who can only charge a maximum of **5%**, for a total max. combined subcontractor mark up of 10%.

For deleted work, the credit for mark-up shall be zero (0) per cent.

10. SUBSTITUTIONS

The Tender amount must be based on materials as specified but Bidders may list any substitutions on the following lines for the Owner's consideration. (See General Conditions and Supplementary General Conditions.)

	ADD TO TENDER	DEDUCT FROM TENDER
1.		
2.		
3.		
4.		

11. IF WE ARE NOTIFIED OF THE ACCEPTANCE OF THIS TENDER WITHIN **60 DAYS** FROM THIS DATE, WE WILL:

1. Execute a Contract on the Canadian Standard Construction Document, Stipulated Price Contract (CCDC Document 2, Revised 2020), as amended by the Supplementary General Conditions.
2. Furnish a Schedule of Values of the Contract Sum, the total aggregating the amount of our Tender.
3. Furnish a Performance Bond and Labour and Material Bond both in the amount of 50% of the Contract Sum, all in accordance with GC.11.2 of the General Conditions and Supplementary General Conditions of the Contract and in the form approved by the Canadian Construction Association.

4. Furnish proof of Workplace Safety and Insurance Board coverage.
5. Certificate of Insurances: Minimum insurance requirements are set out in the Instructions to Bidders and Supplementary General Conditions.

12. CONFLICT DECLARATIONS

1. We declare that this Tender is made without any connection, knowledge, comparison of figures, or arrangements with any other company, firm or person making a Tender for the same work and is in respects fair and without collusion or fraud.

13. SUPPLEMENTARY TENDER FORM

1. The submission of the Supplementary Tender Form is a mandatory requirement of this tender. The failure to submit may result in rejection of your tender.

14. SIGNING OF TENDER

- a. We are submitting this stipulated sum tender under Corporate Seal as a limited company or witnessed as an individual or partnership.

NAME _____

TITLE _____

SIGNATURE OF AUTHORIZED OFFICER OF COMPANY

NAME OF COMPANY _____

ADDRESS _____

PHONE NUMBER _____

CONTACT PERSON _____
COMPANY SEAL:

WITNESS NAME & TITLE _____

WITNESS SIGNATURE _____

DATED AT _____

ON THE _____ 2024.

**NEW HANOVER POLICE SERVICE BUILDING
203, 10TH STREET
HANOVER, ONTARIO
FOR THE
CORPORATION OF THE TOWN OF HANOVER**

SUBMITTED BY: _____

DATE: _____

1. We hereby submit our Separate Prices, Alternate Prices, Unit Prices and List of Subcontractors, including all taxes, excluding HST, in accordance with the Drawings and Specifications prepared by +VG, The Ventin Group Ltd., Architects, 50 Dalhousie Street, Brantford, Ontario.

2. ALTERNATE PRICES

1. The base bid amount is to include all items as specified. Indicate the add or deduct cost for the following Alternate Price items. All prices shall include all applicable taxes, overhead and profit, bonding, insurances and permit and inspection fees, but **EXCLUDE** H.S.T.

Alternate Price 1 To provide T.P.O. roofing system (refer to specifications) instead of the specified Modified Bitumen roofing system included in base bid. Warranty to remain as specified	ADD/DEDUCT: \$_____
<u>Alternate Price 2</u> Delete the 16mm Densdeck specified from the specified roofing system. Include cost to change to a peel and stick vapour retardant membrane directly on steel deck. Warranty to remain as specified.	DEDUCT: \$_____

3. SEPARATE PRICES

1. Indicate the extra cost for the following Separate Price items which are not included in the base bid amount. All prices shall include all applicable taxes, overhead and profit, bonding, insurances and permit and inspection fees, but **EXCLUDE** H.S.T.

<u>This section has been left Blank</u>	
	ADD: \$_____

**SUPPLEMENTARY TENDER
FORM**

4. SUBSTITUTIONS

The Tender amount must be based on materials as specified but Bidders may suggest and list below any substitutions on the following lines for the Owner's consideration. The Owner is under no obligation to accept any or all of these proposed substitutions. (See General Conditions and Supplementary General Conditions.)

Proposed voluntary substitutions	ADD TO TENDER	DEDUCT FROM TENDER
1.		
2.		
3.		
4.		

5. UNIT RATES

- The following unit rates shall be used for the purpose of valuing changes to the Contract in accordance with Part 6 of CCDC Document 2 (Revised 2020).
- Unit rates shall include all cost for labour, transportation, other installation costs, materials, overhead and profit, applicable bonding and other relative charges excluding H.S.T. only.
- The unit rates shall be used for both additions and deductions to the Contract.

1 EARTH EXCAVATION (Including Trucking Charges – off site)

a. Asphalt Paving (supply and installation)

H.L. 3 at specified thickness \$_____ per m²

Granular "A" installed and compacted \$_____ per m³

Granular "B" installed and compacted \$_____ per m³

b. Exterior Work

Sod (supply and installation) \$_____ per m²

**SUPPLEMENTARY TENDER
FORM**

	Bulk Excavation	\$_____	per m ³
	Trench Excavation by machine	\$_____	per m ³
	Hand Excavation	\$_____	per m ³
2	<u>FILL MATERIALS IN-PLACE COMPACTED</u>		
	Class "A"	\$_____	per m ³
	Class "B"	\$_____	per m ³
	Class "C"	\$_____	per m ³
	Clear 3/4" (19 mm) stone	\$_____	per m ³
	Crusher Run	\$_____	per m ³
	Topsoil	\$_____	per m ³
3	<u>CONCRETE</u> (supply and installation)		
	Lean concrete fill, 10 MPa	\$_____	per m ³
	Formwork walls	\$_____	per lin. m
	Formwork in piers	\$_____	per lin. m
	Concrete in footings, 25 MPa	\$_____	per m ³
	Concrete in walls, 25 MPa with 6% air entrainment	\$_____	per m ³
	Concrete in slabs-on-grade, 25 MPa	\$_____	per m ³
	Concrete reinforcement	\$_____	per tonne
	2m wide concrete walkway, including compacted granular "A" and granular "B" bases as specified	\$_____	per lin. m
4	<u>MASONRY</u> (supply and installation)		
	Brick Veneer Masonry	\$_____	per m ²
	140 mm lt. wt. concrete block	\$_____	per m ²
	190 mm lt. wt. concrete block	\$_____	per m ²
	240 mm lt. wt. concrete block	\$_____	per m ²
	290 mm lt. wt. concrete block	\$_____	per m ²

**SUPPLEMENTARY TENDER
FORM**

	Air/Vapour membrane with spray foam insulation	\$_____	per m ²
5	<u>STRUCTURAL STEEL</u> (supply only)		
	Structural steel rolled shapes greater than 31 lb/ft	\$_____	per tonne
	Structural steel rolled shapes less than 31 lb/ft	\$_____	per tonne
	Structural steel HSS members	\$_____	per tonne
	Galvanized steel lintels - supply only	\$_____	per tonne
	Steel lintels - supply only	\$_____	per tonne
	<u>ACOUSTICAL</u> (supply and installation)		
6	600mm x 600mm Grid & ACT	\$_____	per m ²
7	<u>CARPENTRY & DRYWALL READY FOR PAINTING</u> (supply & install, including taping)		
	5/8" drywall (15.9 mm) both sides (at wall locations including 3 5/8" metal studs)	\$_____	per m ²
	5/8" drywall (15.9 mm) drywall at ceiling locations (including metal suspended ceiling system)	\$_____	per m ²
8	<u>FLOORING</u> (supply and installation)		
	Tile (floor)	\$_____	per m ²
	Resilient Sheet Flooring	\$_____	per m ²
	Resilient Textile Flooring	\$_____	per m ²
	Epoxy Seamless Flooring	\$_____	per m ²
	Resilient Athletic Flooring	\$_____	per m ²
6.	<u>SCHEDULE OF HOURLY RATES</u>		
1.	The Contractor and Subcontractors will supply hourly tradesmen for additional work requested to be completed on a "cost plus basis". The rates shall be cost plus markup at rate allowed in this contract.		
2.	Cost shall include and be limited to payroll plus statutory charges. No cost for office charges, supervision or bonuses, etc. are accepted.		

**SUPPLEMENTARY TENDER
FORM**

1	Carpenter	\$_____	per hr.
2	Labourer	\$_____	per hr.
3	Cement Finisher	\$_____	per hr.
4	Electrician Journeyman	\$_____	per hr.
5	Plumber Journeyman	\$_____	per hr.
6	Sheet Metal Mechanic Journeyman	\$_____	per hr.
7	Masonry Journeyman	\$_____	per hr.
8	Painter	\$_____	per hr.
9	Drywaller	\$_____	per hr.
10	Steam Fitter Journeyman	\$_____	per hr.
11	Refrigeration Journeyman	\$_____	per hr.
12	Controls Journeyman	\$_____	per hr.

7. LIST OF SUBCONTRACTORS

1. We submit herewith a list of the subcontractors for Division 2 to 14 we propose to use on this Contract, together with the sections of the work to be done by each of them, reserving to use however, the right to substitute other subcontractors for any of them in the event of any subcontractor withdrawing their tender or becoming bankrupt after the date hereof.
2. Any substitution shall be subject to the approval of the Owner and contingent upon evidence of withdrawal or bankruptcy, satisfactory to the Architect. Fill in the appropriate names for each trade.

	<u>TITLE</u>	<u>NAME OF SUBCONTRACTOR</u>
1	Excavation, Backfilling and Rough Grading	_____
2	Asphalt Paving	_____
3	Curbs and Sidewalks	_____
4	Landscaping, Seed & Sod	_____

5	Concrete work	
6	Precast concrete	
7	Fences	
8	Masonry	
9	Structural Steel	
10	Miscellaneous Metals	
11	Finish Carpentry/Millwork	
12	Air/Vapour Barrier System	
13	Sprayed-On Insulation Air Barrier	
14	Firestopping	
15	Aluminium Cladding System	
16	Membrane Roofing	
17	Sealants	
18	Hollow Metal Doors, Frames, Screens	
19	Wood Doors	
20	Aluminum Doors, Entrances and Curtain Wall Framing	
1	Product	
2	Installer	
21	Glass & Glazing	
22	Gypsum Drywall	
23	Acoustical Tile	

24	Floor & Wall Tile	
25	Athletic Flooring	
26	Resilient Flooring/Sheet Flooring	
27	Epoxy painting	
28	Painting	
29	Whiteboards	
30	Lockers	
31	Manuf. Furnishings	
34	Site Services	
35	Data & Communications	
36	MECHANICAL	
37	ELECTRICAL	

8. SIGNING OF SUPPLEMENTARY TENDER FORM

We are submitting this Supplementary Tender Form under Corporate Seal as a Limited Company or witnessed as an individual or partnership.

NAME _____

TITLE _____

SIGNATURE OF AUTHORIZED OFFICER OF COMPANY _____

NAME OF COMPANY _____

ADDRESS _____

PHONE NUMBER _____

CONTACT PERSON _____

ADDRESS: _____

EMAIL ADDRESS: _____

COMPANY SEAL:

WITNESS NAME _____

WITNESS TITLE _____

WITNESS SIGNATURE _____

DATED AT _____ ON THE _____, 2026.

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 AND ADDRESSES FOR NOTICES IN WRITING

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

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

SC 1.3 ARTICLE A-9 TIME IS OF THE ESSENCE

1.3.1 Add a new Article A-9 as follows:

“ARTICLE A-9 TIME IS OF THE ESSENCE

9.1 The *Contractor* represents and warrants that it will 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*, and agrees that time shall be of the essence in the performance of the *Contractor's* obligations under this *Contract*.”

SC 1.4 ARTICLE A-10 EXECUTION OF THE CONTRACT

1.4.1 Add a new Article A-10 as follows:

“ARTICLE A-10 EXECUTION OF THE CONTRACT

10.1 This *Contract* may be executed in counterparts, each of which shall be deemed an original and both of which, taken together, shall constitute one and the same instrument. Delivery by e-mail of a PDF copy of any executed counterpart shall be deemed to be an original and of full force and effect and equally as effective as delivery of a manually executed original counterpart thereof.”

SC 2. DEFINITIONS

2.1.1 Add the following new Definitions:

(a) **Act**

“*Act* means the Construction Act (Ontario), as amended.”

(b) **As-Built Drawings**

“*As-Built Drawings* means the drawings prepared by the *Contractor* by marking on a copy of the *Drawings* the 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 prepared using the most current version of Autodesk AutoCad as well as in paper and PDF formats.”

(c) **Environmental Programs**

“*Environmental Programs* means the environmental plans, programs, procedures and requirements of the *Owner*, known as the ‘Main Legislative Building Environmental Management Program’.”

(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) **WSIB**

“*WSIB* means the Ontario Workplace Safety & Insurance Board.”

SC 3. GENERAL CONDITIONS

SC 3.1 GC 1.1 CONTRACT DOCUMENTS

3.1.1 Amend paragraph 1.1.2 by adding the following to the end:

“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* in accordance with the *Contract Documents*. 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* 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:

“1.1.5.1 the order of priority of documents, from highest to lowest, shall be

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

3.1.3 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 *Specifications* shall be read as a whole and are the minimum construction requirements. Neither the organization nor the division of the *Specifications* nor anything else contained in the *Contract Documents* will be construed to place responsibility on the *Consultant* to settle disputes among the *Subcontractors* and *Suppliers* in respect to such organization or division.

1.1.9.2 The *Drawings* are intended to convey the scope of the *Work* and indicate elevations and 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 conditions of the pre-grade elevations and 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 satisfy itself and 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*.”

- 3.1.4 Amend paragraph 1.1.11 by deleting the words “at the *Owner’s* expense”.
- 3.1.5 Add new paragraphs 1.1.12 to 1.1.15 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. Except for the obligation to make such review and report the result, the *Contractor* does not assume any responsibility to the *Owner* or the *Consultant* for the accuracy of the *Contract Documents*. Provided it has exercised the degree of care and skill described in paragraph 3.11.1 of GC 3.11 – STANDARD OF CARE, the *Contractor* will 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* that are normally required or normally recognized within respective trade practices as being necessary for the complete execution of the *Work*.
 - 1.1.15 The *Contractor* shall keep one copy of the current *Contract Documents*, *Supplemental Instructions*, proposed or contemplated change notices, *Change Orders*, *Change Directives* record drawings marked up with any changes to be included in *As-Built Drawings*, cash allowance disbursement authorizations, reviewed *Shop Drawings*, reports and records of meetings at the *Place of the Work*, in good order and available to the *Owner* and *Consultant*.”

SC 3.2 GC 2.2 ROLE OF THE CONSULTANT

- 3.2.1 Amend paragraph 2.2.12 by adding the following to the end:
- “If, in the opinion of the *Contractor*, a *Supplemental Instruction* involves an adjustment in the *Contract Price* or the *Contract Time*, the *Contractor* shall, within ten (10) *Working Days* of receipt of a *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 2.2.12 shall be deemed an acceptance of the *Supplemental Instruction* by the *Contractor* without adjustment to the *Contract Price* or *Contract Time*.”

SC 3.3 GC 2.3 REVIEW AND INSPECTION OF THE WORK

- 3.3.1 Amend paragraph 2.3.5 by adding the following to the end of the second sentence:
- “and there shall be no extension of the *Contract Time* resulting from any delay caused by such examination and correction.”

SC 3.4 GC 2.4 DEFECTIVE WORK

- 3.4.1 Amend paragraph 2.4.1 by adding new paragraphs 2.4.1.1 and 2.4.1.2 as follows:
- “2.4.1.1 The *Contractor* shall rectify, in a manner acceptable to the *Owner* and the *Consultant*, all defective *Work* and deficiencies throughout the *Work*, whether or not they are specifically identified by the *Consultant*.
 - 2.4.1.2 The *Contractor* shall prioritize the correction of defective work or deficiencies identified as priorities by the *Owner* or the *Consultant*.”

SC 3.5 GC 3.0 PRECONSTRUCTION SUBMITTALS

3.5.1 Add a new GC 3.0 as follows:

“GC 3.0 PRECONSTRUCTION SUBMITTALS

- 3.0.1 Within 10 *Working Days* of signing this *Contract* and, in any event, before commencing any *Work* the *Contractor* shall submit to the *Owner* all of the following:
- .1 a current *WSIB* clearance certificate;
 - .2 true copies of certificates of insurance evidencing the *Contractor* has secured the insurance policies required by the *Contract Documents*;
 - .3 where applicable, the bonds described in GC 14.7 – CONTRACT SECURITY;
 - .4 documentation of the *Contractor's* safety program to be implemented for the *Project*;
 - .5 a copy of the “Notice of Project” filed with the appropriate government agency or ministry naming the *Contractor* as the “constructor” under *OHSA*; and
 - .6 the construction schedule referred to in paragraph 3.4.1.1 of GC 3.4 – CONSTRUCTION SCHEDULE.”

SC 3.6 GC 3.1 CONTROL OF THE WORK

3.6.1 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*, shall:

- .1 perform the *Work* so as to avoid disturbing the occupants of the *Place of the Work* or the occupants of adjacent premises or the public in general,
- .2 respect and comply with local regulations and all *Owner's* requirements regarding permitted work hours, noise levels and work conditions,
- .3 take all reasonable steps to avoid interference with fire exits, building 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 occupants of the *Place of the Work* or the occupants of adjacent premises and the public in general, and to maintain access to and the operation of any existing facilities at the *Place of the Work*,

.4 take precautions not to allow any unauthorized visitors entry to the *Place of the Work*.

The *Contractor* shall not permit any workers, *Subcontractors* or *Suppliers* 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 Before commencing the *Work* the *Contractor* shall verify, at the *Place of the Work*, all relevant measurements and levels necessary for proper and complete fabrication, assembly and installation of the *Work* and shall further carefully compare such field measurements and conditions with the requirements of the *Contract Documents*. Where dimensions are not included or 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 3.7 GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

- 3.7.1 Amend paragraph 3.2.2 by deleting the word “*Owner*” in the second line and replacing it with the word “*Contractor*”.
- 3.7.2 Delete paragraphs 3.2.2.2 and 3.2.2.3.
- 3.7.3 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”
- 3.7.4 Add a new paragraph 3.2.3.5 as follows:
“3.2.3.5 assume overall responsibility for the *Owner’s* own forces and *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*.”
- 3.7.5 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 3.8 GC 3.4 CONSTRUCTION SCHEDULE

- 3.8.1 Delete paragraph 3.4.1 and replace it with the following:
“3.4.1 The *Contractor* shall:
- .1 within ten (10) *Working Days* of entering into this *Contract*, or within such further time agreed to by the *Owner*, 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 the scheduling program specified by the *Owner*,
 - (b) shall be provided in native editable electronic format that includes and shows all logic links between activities, as well as in PDF and in paper copy, and
 - (c) shall be prepared in collaboration with *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 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 written report on the activities completed since the last meeting and indicating the activities planned to be undertaken in the next two (2) weeks.
- 3.4.2 If at any time it should appear that the actual progress of the *Work* is behind schedule or is likely to fall behind schedule, or if the *Contractor* has so advised the *Owner* and the *Consultant*, 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 the recovery of the schedule.
- 3.4.3 If after applying the expertise and resources required under paragraphs 3.4.1.2 and 3.4.2 the *Contractor* forms the opinion that the slippage in the construction schedule cannot be recovered, the *Contractor* shall give *Notice in Writing* to the *Owner* and the *Consultant* of any revisions required to the schedule.
- 3.4.4 The *Contractor* shall not change the scheduled *Ready-for-Takeover* date.”

SC 3.9 GC 3.5 SUPERVISION

- 3.9.1 Delete paragraph 3.5.1 and replace it with the following:

“3.5.1 The *Contractor* shall provide all necessary supervision and shall appoint a full-time superintendent who shall be in full time attendance at the *Place of the Work* while the *Work* is being performed. The superintendent shall not be changed by the *Contractor* without valid reason, and upon the *Contractor* obtaining the *Owner's* prior written consent, which consent will not be unreasonably withheld.”

SC 3.10 GC 3.6 SUBCONTRACTORS AND SUPPLIERS

- 3.10.1 Add a new paragraph 3.6.1.4 as follows:

“3.6.1.4 ensure that all *Subcontractors* and *Suppliers* and anyone employed or engaged by them directly or indirectly have the qualifications, technical skills, levels of experience and knowledge required (including with respect to all applicable construction safety rules and regulations), and all applicable permits, licenses and approvals necessary to perform the work assigned to them in accordance with the terms of this *Contract*.”

- 3.10.2 Amend paragraph 3.6.2 as follows:

- (a) delete the words “before signing the *Contract*” in the third line of that paragraph; and
- (b) add the following to the end:

“The *Contractor* agrees not to change *Subcontractors* or *Suppliers* without the prior written approval of the *Owner*, which approval will not be unreasonably withheld.”

- 3.10.3 Amend paragraph 3.6.3 by deleting the words “before the *Owner* has signed the *Contract*” in the first line.
- 3.10.4 Add new paragraphs 3.6.7 and 3.6.8 as follows:
- “3.6.7 If the *Contractor* intends to change any *Subcontractors* or *Suppliers*, the *Contractor* shall advise the *Owner* in writing, giving the *Contractor*’s reasons for the proposed change. No change of *Subcontractors* or *Suppliers* may be made without the prior written approval of the *Owner*.
- 3.6.8 Notwithstanding paragraph 3.6.5, the *Owner* may assign to the *Contractor*, and the *Contractor* shall accept the assignment of, any contract procured by the *Owner* for *Work* or *Products* required on the *Project* that has been pre-tendered or pre-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 by way of *Change Order*.”

SC 3.11 GC 3.7 LABOUR AND PRODUCTS

- 3.11.1 Amend paragraph 3.7.1 as follows:
- (a) insert the words “agents, *Subcontractors* 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 *Owner*. Any such job site rules prepared by the *Contractor* shall be consistent with the *Contractor*’s duties and obligations under *OHSA* and shall also 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.”
- 3.11.2 Amend paragraph 3.7.3 by adding the following to the end:
- “The *Contractor* represents and warrants that the *Products* supplied are not subject to any conditional sales contracts and are not subject to any security rights claimed or obtained by any third party which may subject any of the *Products* to seizure and/or removal from the *Place of the Work*.”
- 3.11.3 Add new paragraphs 3.7.4 to 3.7.8 as follows:
- “3.7.4 *Products* provided shall be new and shall conform to all current applicable specifications of the Canadian Standards Association, Canadian Standards Board or General Standards Board, ASTM, National Building Code, Ontario Building Code and all governmental authorities having jurisdiction at the *Place of the Work*, unless otherwise specified. *Products* which are not specified shall be of a quality consistent with those specified and their use acceptable to the *Consultant*. *Products* brought on to the *Place of the Work* by the *Contractor* shall be deemed to be the property of the *Owner*, but the *Owner* shall be under no liability for loss thereof or damage thereto arising from any cause whatsoever, and such *Products* shall be at the sole risk of the *Contractor*.
- 3.7.5 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*.
- 3.7.6 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*.
- 3.7.7 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, 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 conduct 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*.

- 3.7.8 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 on the *Project*. All costs arising from labour disputes arising from the *Contractor's* failure to comply with this paragraph shall be at the sole expense of the *Contractor*."

SC 3.12 GC 3.8 SHOP DRAWINGS

- 3.12.1 Amend paragraph 3.8.2 by adding the following to the end:

"Prior to the first application for payment, the *Contractor* and the *Consultant* shall jointly prepare a schedule of the dates for submission and return of *Shop Drawings*."

- 3.12.2 Delete paragraph 3.8.3.1 and replace with the following

"3.8.3.1 the *Contractor* has determined and correlated the field measurements with the *Shop Drawings* and field construction conditions, *Product* requirements, catalogue numbers and similar data, or will do so if not possible at that time, and"

- 3.12.3 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*, unless there is a scope of work or design change initiated by the *Owner*.
- 3.8.9 The *Contractor* shall not use the term "by others" on *Shop Drawings* but 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 3.13 GC 3.9 USE OF THE WORK

- 3.13.1 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 and *Subcontractors* 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*.
- 3.9.3 The *Owner* shall have the right to enter, occupy, take possession of 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* shall not be deemed

to be the *Owner's* acknowledgement or acceptance of the *Work* or *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 described in the *Contract Documents*, nor shall it entitle the *Contractor* to an adjustment in the *Contract Time* or *Contract Price*, nor shall it 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* obligations, rules, regulations and practices shall continue to apply notwithstanding such entry, occupation, taking of possession or use."

SC 3.14 GC 3.10 CLEANUP

3.14.1 Add a new GC 3.10 as follows:

"GC 3.10 CLEANUP

- 3.10.1 The *Contractor* shall 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. The *Contractor* shall ensure the *Place of the Work* is cleaned and left in a tidy condition on a daily basis. In the event of any dispute regarding the removal of waste products and debris, the *Owner* may remove the said waste products and debris and charge the cost to the *Contractor*.
- 3.10.2 Before delivering the application for *Ready-for-Takeover* the *Contractor* shall remove any and 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 3.15 GC 3.11 STANDARD OF CARE

3.15.1 Add a new GC 3.11 as follows:

"GC 3.11 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 supplying similar services 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 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 3.16 GC 3.12 CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS

3.16.1 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 mechanical and electrical systems or equipment the *Contractor* shall:

- .1 obtain the manufacturer's instructions regarding any 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.
- 3.12.3 If the *Owner* consents 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* and any instructions received from the manufacturers of such systems and equipment; and
 - .2 perform all preventative maintenance services on such systems and equipment in accordance with the *Specifications* and any instructions received from the manufacturers of such systems and equipment; 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 3.17 GC 4.1 CASH ALLOWANCES

3.17.1 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 3.18 GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

3.18.1 Delete GC 5.1.

SC 3.19 GC 5.1A PROPER INVOICE

3.19.1 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* by e-mail to the person / e-mail address designated by the *Owner*; 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 *Work* was performed;
 - .3 information identifying the authority, whether in the *Contract* or otherwise, under which the *Work* was performed;
 - .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;
 - .6 the name, title, telephone number and mailing address of the person to whom payment is to be sent;
 - .7 a statement based on the schedule of values for the *Work*;
 - .8 where the application includes amounts charged on the basis of hourly rates, documentation in support of the amount claimed, including dates that services were

- performed, identity of the person(s) involved, the hours spent, and a description of the services performed;
- .9 where the application includes amounts expended under a cash allowance, documentation in support of the amount claimed, including copies of all invoices and charges incurred;
 - .10 copies of any *Change Orders* and *Change Directives* for which the *Contractor* is claiming payment;
 - .11 for all applications for payment except the final payment, an updated construction schedule that complies with the requirements of paragraph 3.4.1.1 of GC 3.4 – CONSTRUCTION SCHEDULE;
 - .12 a current valid clearance certificate issued by the *WSIB*;
 - .13 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 3.20 GC 5.2 APPLICATIONS FOR PAYMENT

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

“5.2.1 Subject to paragraph 5.2.2, *Proper Invoices* for progress payment shall be given monthly to the *Owner* and the *Consultant* simultaneously as the *Work* progresses on a day of the month agreed to by the parties.

5.2.2 The *Contractor* shall not give a *Proper Invoice* for progress payment between the date certified as the date of *Substantial Performance of the Work* and the date that the *Contract* is completed.”

3.20.2 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.”

3.20.3 Amend paragraph 5.2.4 by adding the following to the end:

“Such schedule of values 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*.”

3.20.4 Amend paragraph 5.2.5 by inserting the words “, or as directed by the *Consultant*” after the words “as specified in the *Contract*”.

3.20.5 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.”

3.20.6 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 14.1 – OWNERSHIP OF MATERIALS.”

SC 3.21 GC 5.3 PAYMENT

3.21.1 Delete paragraph 5.3.1 and replace it with the following:

“5.3.1 After the receipt by the *Consultant* and the *Owner* of an application for payment submitted 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 the *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 *Act*, and subject to the holdback provisions of the *Act*, 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 progress 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 stated in the certificate for payment issued by the *Consultant* pursuant to paragraph 5.3.1.”

SC 3.22 GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

- 3.22.1 Delete paragraphs 5.4.2 through 5.4.5 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 finishing the *Work* and correcting deficient *Work*; and
 - .2 shall cause the certificate to be published in the manner prescribed by the *Act* and shall immediately thereafter 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 valid clearance certificate issued by the *WSIB*; 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 *Act*, the *Owner* will pay the amount authorized by the certificate for payment of the holdback in accordance with the provisions of the *Act*. For certainty, and without limitation, the *Owner* may refuse to pay a portion of the holdback where the *Owner* is entitled to deduct and retain amounts in accordance with the *Contract Documents*.
- 5.4.5 Where the *Consultant* has certified or verified that a portion of the *Work* is 100% complete prior to *Substantial Performance of the Work* the *Owner* may, in its sole and absolute discretion, and subject to the *Contractor's* compliance with the requirements set out below, agree to release to the *Contractor* a portion of the holdback related to the completed portion of the *Work*:
- .1 description of the completed scope of *Work*;
 - .2 completed Declaration of Last Supply as prescribed in section 31(5) of the *Act* (Form 7);
 - .3 completed Certificate of Completion of Subcontract as prescribed in section 33(1) of the *Act* (Form 10);

- .4 *WSIB* Clearance Certificate for the *Contractor*, the *Subcontractor* concerned, and any other subcontractors and *Suppliers* who have provided any services to the *Subcontractor*;
- .5 statutory declaration by an officer of the *Subcontractor* in the form CCDC Document 9B-2001;
- .6 *Contractor's* written acknowledgement to the *Owner* that the requirements of the *Contract Documents* will not be altered by early release of the holdback of the completed subcontract;
- .7 where applicable, written confirmation by the surety company that issued the surety bonds specified in this *Contract* that it has been notified of the *Contractor's* intent to claim early release of holdback and does not object.”

SC 3.23 GC 5.5 FINAL PAYMENT

3.23.1 Delete paragraph 5.5.1 and replace it with the following:

“5.5.1 When the *Contractor* considers that the *Contract* is completed, the *Contractor* shall deliver to the *Owner* and the *Consultant* a *Proper Invoice* for final payment.”

3.23.2 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 *Act*, 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. For certainty, and without limitation, the *Owner* may refuse to pay all or any portion of an application for final 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 stated in the certificate for payment issued by the *Consultant* pursuant to paragraph 5.5.2.”

SC 3.24 GC 5.8 WITHHOLDING OF PAYMENT

3.24.1 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 over-payment 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 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*;
- .2 defective portions of the *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 achieve *Ready-for-Takeover* in accordance with the construction schedule and/or within the *Contract Time*.
- 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 3.25 GC 6.1 OWNER’S RIGHT TO MAKE CHANGES

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

“This requirement 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*.”

3.25.2 Add a new paragraph 6.1.3 as follows:

“6.1.3 The *Contractor* agrees that changes resulting from construction or *Subcontractor* or *Supplier* coordination are included in the *Contract Price* and shall not entitle the *Contractor* to claim any increase to the *Contract Price*.”

SC 3.26 GC 6.2 CHANGE ORDER

3.26.1 Add new paragraphs 6.2.3 to 6.2.5 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 of the *Contractor* and shall be the total cost to the *Owner*; or
 - .2 by unit prices established in the *Contract* 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 *Value Added Taxes*), measured in place prior to excavation, or compacted/complete in place, 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 of labour charged at the prevailing rates at the *Place of the Work* plus statutory charges on labour including workers’ compensation, employment insurance, Canada Pension, vacation pay, medical and health benefits, together with the actual costs, without mark-up, of materials and *Products* utilized in the change, plus the percentage fees set out in the tables below 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 the following maximum mark-ups as a combined percentage fee for overhead and profit:

Increase in Contract Price	Contractor Mark-Up
\$0 to less than \$25,000	10%
\$25,000 to \$49,999.99	7.5%
\$50,000 or more	5%

Interpretive Note: The mark-ups in the above table are flat not graduated. For example, a change valued at \$60,000 attracts a mark-up of 5%.

- (b) On *Work* performed by *Subcontractors*, the *Subcontractors* may charge the following maximum mark-ups as a combined percentage fee for overhead and profit, and the *Contractor* may charge the following maximum mark-ups as a combined percentage fee for overhead and profit on *Work* performed by *Subcontractors*:

Increase in Contract Price	Subcontractor Mark-Up	Contractor Mark-Up
\$0 to less than \$25,000	10%	5%
\$25,000 to \$49,999.99	10%	5%
\$50,000 or more	5%	5%

Interpretive Note: The mark-ups in the above table are flat not graduated. For example, a Subcontractor performed change valued at \$60,000 attracts a mark-up of 5% for the Subcontractor and 5% for the Contractor.

The mark-ups set out in the above tables 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*, warranty, insurance, bonding, job safety costs, and coordination of any and all *Work*-related activities.

- 6.2.4 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*.
- 6.2.5 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 3.27 GC 6.3 CHANGE DIRECTIVE

- 3.27.1 Delete paragraph 6.3.6.3 and replace it with the following:

"6.3.6.3 The *Contractor's* fee shall be equal to the applicable percentage mark-up rates set out in paragraph 6.2.3.3 of GC 6.2 – CHANGE ORDER or as otherwise agreed by the parties."

- 3.27.2 Amend paragraph 6.3.7 as follows:

- (a) insert the words "Subject to paragraph 6.3.14," at the beginning; and
- (b) delete paragraphs 6.3.7.1(1), (2), (3) and (4) and replace them with the following:

- “(1) performing the *Work*, including necessary supervisory services;
- (2) engaged in the preparation of *Shop Drawings*, fabrication drawings, coordination drawings and *As-Built Drawings*; or
- (3) including clerical staff engaged in processing changes in the *Work*.”

3.27.3 Amend paragraph 6.3.12 by adding 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*.”

3.27.4 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 project managers, superintendents, 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*;
- .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*;
- .8 amounts for small tools;
- .9 insurance and bonding premiums, unless such costs or fees are approved in writing by the *Owner*; and
- .10 preparation of *As-Built Drawings*.”

SC 3.28 GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

3.28.1 Add a new paragraph 6.4.0 as follows:

“6.4.0 The *Contractor* confirms that, before entering into 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 applied to such investigation and examinations the degree of care, skill, judgment and diligence described in paragraph 3.11.1 of GC 3.11 – STANDARD OF CARE. If the *Contractor* has not conducted the investigations and examinations described in this paragraph, it is deemed to assume all risk of conditions or circumstances now existing or arising in the course of the *Work* which could make the *Work* more expensive or more difficult to perform than was contemplated at the time the *Contract* was entered into. 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 by such investigations or examinations made before entering into this *Contract*.”

3.28.2 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.”

3.28.3 Amend paragraph 6.4.2 as follows:

(a) add a new first sentence as follows:

“Having regard to paragraph 6.4.0, if the *Contractor* believes that the conditions of the *Place of the Work* differ materially from those reasonably anticipated, or differ materially from those indicated in the *Contract Documents*, or were concealed from discovery notwithstanding the conduct of the investigation described in paragraph 6.4.0, it shall notify the *Owner* and *Consultant* in writing no later than five (5) *Working Days* after first observing such conditions.”

(b) insert the words “and were concealed from discovery notwithstanding the conduct of the investigations and examinations described in paragraph 6.4.0” after the word “materially” in the second line.

SC 3.29 GC 6.5 DELAYS

3.29.1 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 the costs of the *Contractor’s* head office personnel and overhead costs, any consequential, indirect or special damages, and any loss of profit or loss of opportunity costs and damages arising from or caused by such delay, regardless of whether any such excluded costs, damages or claims are made or incurred by the *Contractor* or any *Subcontractor* or *Supplier*.”

3.29.2 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 the costs of the *Contractor’s* head office personnel and overhead costs, any consequential, indirect or special damages, and any loss of profit or loss of opportunity costs and damages arising from or caused by such delay, regardless of whether any such excluded costs, damages or claims are made or incurred by the *Contractor* or any *Subcontractor* or *Supplier*. 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.”

3.29.3 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) delete the last sentence of paragraph 6.5.3 and replace it with the following:

“The *Contractor* shall not be entitled to payment for costs incurred by such delays.”

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

“For greater certainty, 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 any adjustment to the *Contract Time* shall only be to the extent that the critical path of the *Work* is affected. Without in any way limiting the generality of the foregoing, it is a condition precedent to the *Contractor’s* claim for extension of the *Contract Time* and for additional compensation or reimbursement of costs that the notice provisions in this paragraph be strictly adhered to in each instance, except where the event of delay itself reasonably precludes strict adherence to such notice provisions. If the *Contractor* fails to comply with such notice provisions, it shall be deemed to have waived the right to claim for the effects of delay.”

3.29.5 Add new paragraphs 6.5.6 to 6.5.9 as follows:

- “6.5.6 The *Contractor* shall take all reasonable steps to reschedule the *Work* and to minimize the effect of the delay referred to in paragraphs 6.5.1, 6.5.2 and 6.5.3. If the *Contractor* fails to do so, the extension of the *Contract Time* and/or any amounts payable to the *Contractor* will be reduced accordingly.
- 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 or 6.5.3, and the *Contractor* 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 The parties acknowledge and agree 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*.
- 6.5.9 If the *Contractor* is delayed in the performance of the *Work* by an act or omission of the *Contractor* or anyone employed or engaged by the *Contractor* directly or indirectly, or by any cause within the *Contractor's* control, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may decide in consultation with the *Owner*. 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 this paragraph, at its sole cost and expense. In addition, the *Owner* shall be reimbursed by the *Contractor* for all reasonable costs and expenses incurred by the *Owner* as a result of such delay including, but not limited to, the costs of all 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 3.30 GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

3.30.1 Delete paragraph 7.1.2 and replace it with the following:

- “7.1.2 If the *Contractor* neglects to prosecute the *Work* properly, fails or neglects to maintain the construction schedule, or otherwise fails to comply with the requirements of the *Contract*, 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.”

3.30.2 Add new paragraphs 7.1.5A and 7.1.5B as follows:

- “7.1.5A The *Owner* may terminate the *Contract* at any time for any or no reason. In such event, the *Owner* shall pay for the *Work* performed up to the effective date of termination and for such additional direct costs, if any, directly flowing from such termination which are a reasonable consequence of the termination, but excluding the costs of the *Contractor's* head office personnel and overhead costs, any consequential, indirect or special damages, and any loss of profit or loss of opportunity costs and damages arising from or caused by such termination, regardless of whether any such excluded costs, damages or claims are made or incurred by the *Contractor* or any *Subcontractor* or *Supplier*. The *Owner* shall not be liable to the *Contractor* for any other claims, costs or damages whatsoever arising from such termination of the *Contract*.

7.1.5B 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*.”

3.30.3 Add a new GC 7.1A as follows:

“GC 7.1A OWNER’S RIGHT TO SUSPEND THE WORK

7.1A.1 The *Owner* may, at any time and from time to time, suspend performance of the *Work* for up to 20 *Working Days* in the aggregate by giving *Notice in Writing* to the *Contractor* indicating the length of the suspension. Upon receiving a notice of suspension the *Contractor* shall, subject to any directions in the notice of suspension, suspend performance of the *Work*.

7.1A.2 The *Contractor* shall be responsible for the care, maintenance and protection of the *Project* during any period of suspension, and the *Contractor* 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.

7.1A.3 If the *Work* is suspended pursuant to paragraph 7.1A.1 the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Owner* and the *Contractor*. The *Contractor* shall not be entitled to payment for costs incurred as a result of any suspension pursuant to this GC 7.1A.

**SC 3.31 GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR
TERMINATE THE CONTRACT**

3.31.1 Delete paragraph 7.2.2.

3.31.2 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 the *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.”

3.31.3 Amend paragraph 7.2.4 by deleting the number “5” in the second line and replacing it with “10”.

3.31.4 Delete paragraph 7.2.5 and replace it with the following:

“7.2.5 If the default cannot be corrected within the 10 *Working Days* 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 an acceptable 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. Subject to the *Contractor's* obligation to mitigate costs, the *Contractor* shall also be entitled to recover the costs directly flowing from and which are a reasonable consequence of the termination, but excluding the costs of the *Contractor's* head office personnel and overhead costs, any consequential, indirect or special damages, and any loss of profit or loss of opportunity costs and damages arising from or caused by such termination, regardless of whether any such excluded costs, damages or claims are made or incurred by the *Contractor* or any *Subcontractor* or *Supplier*. Such payment is further subject to the *Owner's* right to claim damages or set off for any costs or loss or damage suffered or which will be suffered by the *Owner*. 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 3.32 GC 8.4 RETENTION OF RIGHTS

3.32.1 Add a new paragraph 8.4.3 as follows:

"8.4.3 If either party elects to have a dispute resolved by arbitration, the *Contractor* agrees that this paragraph 8.4.3 shall be construed as a formal consent to the stay of any lien proceedings until an award is rendered in the arbitration or such dispute is otherwise resolved between the parties. Provided that nothing in this paragraph shall prevent the *Contractor* from taking the steps required by the *Act* to preserve and/or perfect a lien to which it may be entitled."

SC 3.33 GC 9.1 PROTECTION OF WORK AND PROPERTY

3.33.1 Delete paragraph 9.1.1.1 and replace it with the following:

"9.1.1.1 errors or omissions in the *Contract Documents* which the *Contractor* could not reasonably have discovered; or"

3.33.2 Delete paragraph 9.1.2 and replace it with the following:

"9.1.2 Before commencing any *Work*, the *Contractor* shall determine the locations of all underground utilities and structures indicated in the *Contract Documents* or that are discoverable by applying to an inspection of the *Place of the Work* the degree of care and skill described in this *Contract*."

3.33.3 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 costs, 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*."

SC 3.34 GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

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

3.34.2 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*".

- 3.34.3 Amend paragraph 9.2.5.3 by adding the following after the words “*Place of the Work*” in line two:
“and no property is damaged or destroyed as a result of exposure to or the presence of the toxic or hazardous substances,”
- 3.34.4 Add a new paragraph 9.2.5.5 as follows:
“9.2.5.5 take all necessary steps to mitigate the impact on *Contract Time* and *Contract Price*.”
- 3.34.5 Amend paragraph 9.2.6 by inserting the following after the word “responsible”:
“or whether any toxic or hazardous substances or materials already at the *Place of the Work* (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damage to the property of the *Owner* or others,”
- 3.34.6 Amend paragraph 9.2.7.3 by adding the following after the words “as a result of the delay” at the end:
“, but excluding the costs of the *Contractor’s* head office personnel and overhead costs, any consequential, indirect or special damages, and any loss of profit or loss of opportunity costs and damages arising from or caused by such delay, regardless of whether any such excluded costs, damages or claims are made or incurred by the *Contractor* or any *Subcontractor* or *Supplier*”
- 3.34.7 Delete paragraph 9.2.7.4.
- 3.34.8 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,”
- 3.34.9 Add new paragraphs 9.2.10 and 9.2.11 as follows:
“9.2.10 Without limiting its other obligations under this GC 9.2, the *Contractor* acknowledges that its obligations under the *Contract* include compliance with the *Environmental Programs*. The *Contractor* acknowledges that the *Owner* may suffer loss and damage should the *Contractor* fail to comply with the *Environmental Programs* and agrees to indemnify and hold harmless the *Owner* with respect to any loss or damage to which the *Owner* is exposed by the *Contractor’s* failure to comply. The *Contractor* acknowledges that should it fail to comply with the *Environmental Programs*, such failure will constitute a failure to comply with the requirements of the *Contract* in a material way within the meaning of paragraph 7.1.2 of GC 7.1 – OWNER’S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR’S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT.
9.2.11 The *Contractor* shall indemnify the *Owner* and its agents, officers, directors, employees, consultants, successors and assigns 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 agents, officers, directors, employees, consultants, successors and assigns

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 3.35 GC 9.4 CONSTRUCTION SAFETY

3.35.1 Add new paragraphs 9.4.6 to 9.4.10 as follows:

- “9.4.6 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”.
- 9.4.7 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. 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*.
- 9.4.8 The *Contractor* shall indemnify and save harmless the *Owner* and its and its agents, officers, directors, employees, 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.
- 9.4.9 Without limiting the generality of the foregoing, the *Contractor* shall follow all general instructions and work procedures specified in the *Environmental Programs* and sign and return the acknowledgment form. The *Contractor* shall also ensure that their employees, *Subcontractors* and *Suppliers* who will work at the *Place of the Work* have the appropriate asbestos awareness training certificates.
- 9.4.10 The *Contractor* shall comply with all site access and entry protocols and guidelines established by the *Owner*.”

SC 3.36 GC 9.5 MOULD

3.36.1 Amend paragraph 9.5.3.3 by adding the following after the words “as a result of the delay” at the end:

“; but excluding the costs of the *Contractor’s* head office personnel and overhead costs, any consequential, indirect or special damages, and any loss of profit or loss of opportunity costs and damages arising from or caused by such delay, regardless of whether any such excluded costs, damages or claims are made or incurred by the *Contractor* or any *Subcontractor* or *Supplier*”

SC 3.37 GC 10.1 TAXES AND DUTIES

3.37.1 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 and the *Owner* shall not be entitled to any credit relating to mark-up for overhead or profit on any decrease in such taxes and duties.”

3.37.2 Add new paragraphs 10.1.3 to 10.1.6 as follows:

“10.1.3 Where 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 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 3.38 GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

3.38.1 Amend paragraph 10.2.2 by adding the following to the end:

“The Contractor shall pay any construction damage deposits levied by the authorities having jurisdiction in connection with the issuance of the building permit.”

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

“The *Contractor* shall notify the *Consultant* and the chief building official or the registered code agency where applicable, of the readiness, substantial completion, and completion of the stages of construction set out in the Ontario Building Code. The *Contractor* shall be present at each site inspection by an inspector or registered code agency. If any laws, ordinances, rules, regulations, or codes conflict, the more stringent shall govern.”

3.38.3 Amend paragraph 10.2.5 by deleting the word “The” in the first line and replacing it with the words “Subject to paragraph 1.1.12 of GC 1.1 – CONTRACT DOCUMENTS, the”.

3.38.4 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”.

3.38.5 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 3.40 GC 12.1 READY-FOR-TAKEOVER

3.40.1 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 final *As-Built Drawings* acceptable to the *Consultant*.”

3.40.2 Add a new paragraph 12.1.1.9 as follows:

“12.1.1.9 Written confirmation by the *Consultant* that the aggregate cost of completing the remaining *Work* and correcting known defects and deficiencies is not more than the lesser of \$5,000 and 1% of the *Contract Price*.”

3.40.3 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*.”

3.40.4 Delete paragraph 12.1.6.

SC 3.41 GC 12.2 EARLY OCCUPANCY BY THE OWNER

3.41.1 Delete GC 12.2.

SC 3.42 GC 12.3 WARRANTY

3.42.1 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*.”

3.42.2 Amend paragraph 12.3.3 by adding the following to the end:

“The *Contractor* shall correct all remedial and warranty work identified in the *Notice in Writing* within 30 days of receipt of such notice, or within such other time as the parties may agree, failing which the *Owner* may engage others to perform the work necessary to complete and rectify such warranty work at the risk and cost of the *Contractor*.”

3.42.3 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.”

SC 3.43 GC13.1 INDEMNIFICATION

3.43.1 Delete paragraphs 13.1.1 through 13.1.6 and replace them with the following:

“13.1.1 The *Contractor* shall defend, indemnify and hold harmless the *Owner* and the *Consultant*, their agents and employees from and against all claims, demands, damages, losses, expenses, costs including legal fees, actions, causes of action, suits, charges or other proceedings (collectively “Claims”), by whomsoever made, brought or prosecuted in any manner, arising out of, resulting

from or attributable to, directly or indirectly, the *Contractor's* or any *Subcontractor's* performance or non-performance of the *Work* or the *Contract*, regardless of whether or not caused in part by a party indemnified hereunder. It is expressly understood that the *Contractor* will save harmless the *Owner* from all *Claims* made by any person other than the *Contractor* itself, financial or otherwise, relating to or arising from the *Work*.

- 13.1.2 The *Owner* shall indemnify and hold harmless the *Contractor* and its agents and employees from and against all *Claims* arising out of the *Contractor's* performance of the *Contract* which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the *Place of the Work*.”

SC 3.44 GC 13.2 WAIVER OF CLAIMS

- 3.44.1 Delete paragraphs 13.2.1 through 13.2.10 and replace them with the following:

“13.2.1 As of the date on which the *Owner* makes final payment to the *Contractor*, the *Owner* expressly waives and releases the *Contractor* from all claims against the *Contractor* including, without limitation, those that might arise from negligence or breach of contract by the *Contractor* except for one or more of the following:

- .1 those made in writing prior to the date of the final payment and still unsettled;
- .2 those arising from the provisions of GC 13.1 – INDEMNIFICATION or GC 12.3 – WARRANTY;
- .3 those arising from GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES and arising from the *Contractor* bringing or introducing any toxic or hazardous substances to the *Place of the Work* after the *Contractor* commences the *Work*;
- .4 those made by *Notice in Writing* within a period of six years from *Ready-for-Takeover*, or within such shorter period as may be prescribed in any limitation statute of the province or territory of the *Place of the Work* and arising from any liability of the *Contractor* for damages resulting from the *Contractor's* performance of the *Contract* or substantial defects or deficiencies in the *Work* for which the *Contractor* is proven responsible.

13.2.2 As of the date of *Ready-for-Takeover*, the *Contractor* expressly waives and releases the *Owner* from all claims which it has or reasonably ought to have knowledge of that could be advanced against the *Owner* including, without limitation, those that might arise from the negligence or breach of contract by the *Owner* except:

- .1 those for which *Notice in Writing* was given prior to the *Contractor's* application for *Ready-for-Takeover* and still unsettled; and
- .2 claims for payment for *Work* completed after the *Contractor's* application for *Ready-for-Takeover*; and
- .3 those arising from the provisions of GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES or GC 10.3 – PATENT FEES.”

SC 3.45 PART 14 – OTHER PROVISIONS

- 3.45.1 Add a new “PART 14 – OTHER PROVISIONS” as follows:

“PART 14 OTHER PROVISIONS

GC 14.1 OWNERSHIP OF MATERIALS

14.1.1 Unless otherwise specified, all materials existing at the *Place of the Work* at the time this *Contract* is entered into shall remain the property of the *Owner*. All *Work* and *Products* delivered to the *Place of the Work*, or to a pre-approved off site storage area, shall be the property of the *Owner*. The *Contractor* shall remove all surplus or rejected materials from the *Place of the Work* as its property when notified in writing to do so by the *Consultant*.

GC 14.2 LIENS AND ACTIONS

14.2.1 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.

- 14.2.2 If a lien action is commenced arising out of a lien described in paragraph 14.2.1, 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.
- 14.2.3 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 14.3 CONTRACTOR LIABILITY FOR DAMAGES

- 14.3.1 Notwithstanding any other provision in this *Contract*, if the *Owner*, as a result of the *Contractor's* act or omission or breach of this *Contract*, incurs damages, costs, fees or expenses, including costs of additional services performed by the *Consultant* and including legal fees, whether or not such act, omission or breach results in any lien, lien action or other legal proceeding, and whether or not such act, omission or breach results in the *Owner* taking any of the steps provided for in GC 7.1, all such damages, costs, fees (including legal fees on a full indemnity basis) and expenses shall be charged to the *Contractor* and the *Owner* shall be entitled to set off and deduct all such damages, costs, fees (including legal fees on a full indemnity basis) and expenses 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 of the said damages, costs, fees and expenses.

GC 14.4 DAILY REPORTS / DAILY LOGS

- 14.4.1 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*.
- 14.4.2 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 14.4.1 and other records which document the activities of the *Contractor*.
- 14.4.3 Upon request by the *Owner* or the *Consultant*, the *Contractor* shall make available for inspection and copying all of the records generated pursuant to this GC 14.4, along with any other routine *Project* records ordinarily maintained by the *Contractor*.

GC 14.5 PUBLIC STATEMENTS

- 14.5.1 The *Contractor* shall not, and shall ensure its employees, *Subcontractors* and *Suppliers* do not, publish any photographs or images, issue or make any statements or news releases, electronic or otherwise, on any website or social media or other communications platform, concerning the *Owner*, the *Contract*, the *Work*, or the *Project*, 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 by the *Contractor*, its employees, *Subcontractors* and *Suppliers* in which the *Owner* is mentioned 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 without the prior written approval of the *Owner*.

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, after receiving written notification from the *Owner*, and prior to commencing the *Work*, deliver to the *Owner* the performance bond and labour and material payment bond specified in the *Contract Documents*, each in the amount specified by the *Owner*.
- 14.7.2 The form of such bonds shall be in accordance with the latest edition of the CCDC approved bond forms and 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*."

END OF SUPPLEMENTARY CONDITIONS

1. GENERAL

1. Unless specified otherwise, the following instructions shall apply to all sections of the work.
2. Conform to The latest Ontario Building Code, CEC CSA C22, CAN3-B44 and CSA W59.1 - latest amendments, where applicable, to the Canadian Code for Construction Safety, as currently amended, and to the Construction Safety Act, Ont. as currently amended, and to all other applicable codes and Building By-Laws hereinafter referred to as Codes; and to the requirements of the authorities having jurisdiction, including public utilities, referred to in the Contract Documents as the authorities.
3. Conform to regulations of Municipality having jurisdiction regarding clean up of tracking on streets and protection of sidewalks and curbs, and all other applicable laws, By-laws and Regulations.
4. Read General Work - Section 010150, for instructions and requirements regarding General Work and Services, Miscellaneous Work and Services and Temporary Work and Services. Trades requiring own offices, sheds, etc. shall provide, maintain, relocate and remove same in a manner satisfactory to Contractor.
5. Wherever possible, give preference to use of local labour, building mechanics, suppliers and subcontractors.
6. Install and arrange ducts, piping, tubing, conduit, equipment and fixtures in such a way as to conserve head room and space as much as possible, to provide minimum interference and to be neat, orderly and tidy. Unless otherwise noted, run pipes, ducts, tubing and conduit vertical, horizontal and square with building grid. Conceal pipes, ducts, tubing and conduit above ceilings, behind furrings, in walls, except in mechanical rooms, equipment rooms and unfinished spaces, unless indicated or specified otherwise.
7. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference shall apply to as many such devices as are required to complete the installation.
8. Construction Site Live Web Cam
 1. Wherever a web cam is installed and a link provided for access to live feeds, please be advised that the Architect and its' consultants shall not be responsible for monitoring any such feeds nor will access to these feeds imply that any party has/had knowledge of any site activity. Access to web cam feeds shall not be part of nor used in lieu of the Architect and its' consultants regular general conformance site reviews.
9. Definitions
 1. Wherever the words 'approved', 'satisfactory', 'directed', 'permitted', 'inspected', 'instructed', 'required', 'submit', 'ordered', or similar words or

phrases are used in the Contract Documents, it shall be understood, unless the context provides otherwise, that the words 'by (to) the Architect' follow.

2. The words 'by others' when used in the Specifications or on the Drawings shall not mean by someone other than the Trade Contractor. The only means by which something shown or specified shall be indicated as not being in the Contract is by the use of the initials 'NIC' or the words 'not in (the) Contract', 'by Client', or by another Contractor.
3. Exposed: means when visible by the occupants at completion of the work, unless scheduled or specified otherwise.
4. The use of "scope", "related work", or similar articles in the specifications shall not relieve the contractor from their responsibility to assign the various parts of the work to the appropriate subcontractors and forces and shall not impose upon the Architect or Client the duty to arbitrate disputes between the Contractor and the Subcontractor, nor shall it relieve the subcontractors from their responsibility for carefully examining all the Drawings and Specifications and coordinating their work with each other and the Contractor.

2. CO-OPERATION

1. Co-operate and co-ordinate with other trades as required, for satisfactory and expeditious completion of work. Take field dimensions relative to work. Fabricate and erect work to suit field dimensions and field conditions. Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to, or inserted in work, and set in place or instruct related trades as to their location. Pay cost of extra work caused by and make up time lost, as a result of failure to provide in adequate time, the necessary co-operative information of items to be fixed to, or built in.
2. Allow for four (4) site tours by Owner staff to be scheduled throughout construction. Provide safety helmets and vests for twelve (12) persons. It is the Contractors responsibility to lead the tour to ensure safe passage through the work area.

3. MATERIALS

1. Reject material damaged in transit. Store packaged materials in original undamaged containers with manufacturer's labels and seals intact. Handle and store materials in accordance with manufacturers' and suppliers' recommendations. Prevent damage. Remove from site and replace damaged materials.

4. EXAMINATION

1. The site shall be accepted by the Contractor in their present condition. The Contractor will be held to have visited the site and to have carefully examined all conditions affecting the work to be done there on, including the location of all

services which may have to be protected, removed or relocated. The Contractor shall accept sole responsibility for any error or neglect on their part in this respect. Submission of Tender shall be deemed confirmation that tenderer has inspected site and is thoroughly conversant with existing conditions. No claims for extra payment will be considered for extra work, expense or difficulties encountered due to conditions on each site which were visible upon or reasonably inferable from an examination of the said site prior to the closing of tenders.

2. Examine the specifications, drawings and soils report thoroughly. Report to Architect all ambiguities, discrepancies, omissions, errors, departures from Building By Laws, or from good practice, discovered during examination as early in the tender period as possible to allow clarification by addenda to be issued to all bidders. No claims for extra payment will be considered for work, expense or difficulties which are reasonably inferable from an examination of the documents prior to the closing of tenders.
3. Examine work upon which your work depends. Application of your work or any part of it shall be deemed acceptance of work upon which your work, or that part of it which has been applied, depends.
4. Drawings are in part, diagrammatic and incomplete, and are intended to convey the general scope of work and indicate general and approximate location, arrangement and size of fixtures, devices, equipment, ducts, piping, conduit and outlets. Obtain more accurate information about locations, arrangement and sizes from study and coordination of construction drawings, including architectural, structural, mechanical and electrical and become familiar with conditions and spaces affecting these matters before proceeding with work.
5. Where job conditions require reasonable changes in indicated location and arrangements, make changes at no extra cost to Client. Install and arrange ducts, piping, conduit, equipment and fixtures in such a way as to conserve head room and space as much as possible.
6. The drawings and specifications complement each other, and neither is to be considered alone. Hence, any item omitted in one, but mentioned or implied in the other, must be provided.
7. All changes to the contract documents which result in an extra or a credit to the contract amount are not to be executed until written instructions have been received and the extra or credit agreed to in writing by all parties to the contract.
8. The Contractor shall execute variations, alterations and substitutions which do not affect the contract amount as instructed by the Owner or its representatives.
9. Bidders finding discrepancies or omissions in the drawings or specifications shall at once notify the Architect who shall send written instructions to all bidders. Bidders may, during the tender period, be advised by addenda of any additions, alterations or deletions to the specifications and drawings. All such changes shall be covered by the tender and become part of the contract documents.

10. If any person submitting a bid on this project is in doubt as to the true meaning and intent of any part of the specifications or other documents, he must request an interpretation from the Architect. If such interpretation is not requested, the bids will be presumed to be based on the interpretation or directions that may be subsequently given by the Architect after award of the Contract, in accordance with the provisions of the Contract.
11. Prior to the closing date of tenders, any and all necessary clarifications of the specifications or other Tender documents will be in the form of written Addenda. The Architect will NOT be responsible for verbal instructions or any explanations or interpretation of Drawings and Specifications.

12. SCAFFOLDING

1. The Contractor shall provide at their own expense all manner of materials, labour, scaffolding, ladders, hand tools, and appliances necessary for the due execution and proper completion of work described herein, unless otherwise specified in tender specifications.
2. Erect scaffolding independent of walls. Use scaffolding so as to interfere as little as possible with other trades. When not in use, move scaffolding as necessary to permit installation of other work. Construct and maintain scaffolding in rigid, secure and safe manner. Remove scaffolding promptly when no longer required. Scaffolding must comply to Occupational Health and Safety Act.

13. FLOOR SURFACES

1. Adequately protect existing and new floors and finishes from damage. Take special measures when moving heavy loads or equipment on them.
2. Keep floors free of oils, grease, or other material likely to damage them, discolour them, or affect bond of applied finishes.
3. Once building is enclosed, keep floors as dry as possible after curing.

14. PROTECTION AND MAKING GOOD

1. Protect existing property, adjacent public and private property and work of other sections from damage while doing work. This shall include hoarding, fences or other means to protect adjacent property, adjacent buildings and the attached Town of Hanover municipal building.
2. Limit dust and noise as far as possible to minimise disturbance to users of the adjacent municipal building and adjacent property users.
3. Damaged work and property shall be made good (includes replacing, fixing, re-finishing) wherever possible by those performing work originally, but at expense of those causing damage.

4. Attach and fasten fixtures and fittings in place in safe, sturdy, secure manner so that they cannot work loose or fall or shift out of position during occupancy of building as a result of vibration or other causes in normal use of building.
5. If, during work, any buildings, curbs, walks, roads or landscaping are damaged, repair or replace them to the satisfaction of Architect and the local jurisdiction.
6. Protect glass and other finishes against heat, slag and weld spatter, by erecting sturdy plywood or other heavy shield.
7. If tape or strippable coatings are used to protect finished metal surfaces, do not allow them to become baked on or to thermoset.

15. IMPACT DRIVEN FASTENINGS

1. Do not use impact driven (explosive, hammer, etc., but not twist driven) fastening devices without written approval. Properly size holes in concrete and drill cleanly to avoid oversizing for expansion anchors. When drilling upward, use jig to hold drill steady and plumb.

16. ALTERATIONS AND MAKING GOOD

1. Wherever it becomes necessary to cut or interfere in any manner with existing services and apparatus, do so at such times as approved by the Architect. Give minimum advance notice of one week and provide sufficient information of such requirements.
2. Take into account existing installations to ensure best arrangement of pipes, conduit, ducts and mechanical, electrical and other equipment in available space. For critical locations, prepare interference and installation drawings showing work of various sections as well as existing installations, for approval, before commencing work.
3. Comply with Section 010450 Cutting and Patching for additional information

17. STANDARDS

1. Where initials of an organization are used, followed by number or combination of numerals and letters, this designates a standard produced by the organization. Conform to issue of standard so designated, as amended and revised to date of contract. When designation does not indicate particular edition of standard edition current at date of Contract shall apply.
2. Wherever a standard confers upon a person, a body politic or a body corporate the right to approve, to select, to exercise authority or to interpret the standard, and refers to that person, body politic or body corporate as the Authority having jurisdiction, the Authority, the Engineer, the Department, the Purchaser, the Contracting Officer (e.g. U.S. Fed. Spec.) or by some other such designation, the Architect shall have the right to exercise the powers of any such person, body politic, or body corporate.

3. Where standards and manufacturer's instructions conflict with the Contract Documents, the Contract Documents shall govern.

18. FINISHED DIMENSIONS AND ELEVATIONS

1. See Article on Setting Out, in Section 010150. Give particular attention to finished dimensions and elevations of the work. Make finished work fit indicated spaces accurately. Make finished work flush, plumb, true to lines and levels and accurate in all respects

19. TRADEMARKS AND LABELS

1. Trademarks and labels shall not be visible in the finished work except for labels of ULC and other similar authorities and except where necessary to identify mechanical and electrical equipment, for maintenance and replacement and except where specified otherwise.
2. Except as provided in the foregoing paragraph, locate trademarks and labels on concealed or inconspicuous surfaces or remove by grinding if necessary or paint out where surface painted, if located conspicuously.

20. BURIED SERVICES

1. The Contractor shall be responsible for locating and keeping records of all buried services. The subcontractors concerned shall provide the Contractor with all necessary dimensions required to accurately locate those services.

21. EXISTING SERVICES

1. Where work involves breaking into or connecting existing services, carry out work at times directed by governing authorities, with minimum of disturbance to the operation of the facility, pedestrian and vehicular traffic.
2. Before commencing work, establish location and extent of service lines in area of work and notify Architect of findings.
3. Where unknown services are encountered, immediately advise Architect and confirm findings in writing.
4. Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
5. Remove abandoned service lines to distance of six feet from foundations. Cap or otherwise seal lines at cut-off points, in manner approved by authorities having jurisdiction over service.
6. Record locations of maintained, re-routed and abandoned service lines. The sub-contractors concerned shall provide the General Contractor with all necessary dimensions required to accurately locate those services.

7. The appropriate Sub-contractor shall assume full responsibility for the locations and protection of all under and above ground utilities, such as water, sewer and gas mains and building connections, hydro and telephone poles, wires and conduits, etc. when excavating or digging below grade whether they are shown on the plans or not.
8. Where the location of any of these utilities has been shown on the plans, such information is not guaranteed. It is the appropriate Sub-contractor's responsibility to verify locations, invert elevations, etc., immediately after moving on the site. If for any reason the information obtained necessitates changes in procedures or design, advise the Architect at once. If this verification of existing conditions is not done at the outset and any problems arise, the responsibility for same will be entirely the Contractor's.
9. Contractor to provide temporary support of existing service lines and pipes where work requires excavation below existing lines for construction of new footings, foundations, etc.

22. EMBEDDED CONDUIT, PIPE AND SLEEVES

1. Concrete Slabs
 1. All pipes and conduits shall be depressed to pass under concrete slabs on grade.
 2. Sleeves, conduits and pipes which pass through suspended slabs, beams or walls, shall be in approved locations which do not impair the strength of the construction. Space them all not less than three diameters o.c.

23. SOUND ATTENUATING PARTITIONS

1. Avoid "short circuiting" sound attenuating partitions by the careful location and treatment of ducts, grilles, diffusers, etc., and of electrical outlets and boxes, etc. Where electrical boxes are back to back, serving each side, locate them at least 10 inches (250 mm) apart laterally and if interconnected, use flexible connections.

24. SAFETY

1. The General Contractor will be responsible for submitting their safety program used in the ongoing operation of their company and any safety recommendations specifically relating to the tendered project.
2. Safety measures or procedures taken by the General Contractor i.e. site safety meetings, site construction fences, etc., will not relieve the Contractor of their responsibilities for the safety of persons and property, and for compliance with the federal, provincial and local statutes, rules, regulations and orders applicable to the conduct of the work.
3. The Contractor shall be responsible to maintain safe exit paths from the existing

building during all stages of construction. A fire safety plan shall be submitted during construction staging and scheduling discussions with the Owner and Consultants.

4. Submit copies of all Safety Meeting Minutes to Architect and Client.
5. Comply with Section 015450.

25. OMISSIONS AND DISCREPANCIES

1. Notify Architect at once of discrepancies found in, or omissions from the drawings, specifications or other documents or if in doubt as to their meaning; Architect will send a written instruction to all Bidders. If a discrepancy exists, the Architect will issue an addendum to all Bidders to clarify or correct such discrepancies.
2. Neither Client nor Architect will be responsible for any verbal instructions.
3. Should any discrepancies or omissions go unreported to the Architect during tendering period, the proper interpretation shall be at the discretion of the Architect.

26. PROCEDURES AND SUPPLY OF CRITICAL MATERIALS

1. Submission of a tender shall constitute the Tenderer's agreement that they will commence work immediately upon award of the Contract, and that they will execute the same without interruption until completion, including the furnishing of all necessary supplies and equipment for winter operations. Contractor shall assure themselves before submitting a tender that they are in a position to furnish adequate supplies of all materials, critical or otherwise, at such times necessary to ensure immediate commencement of the work and continuous operation without delays on the project. The Contractor shall include in their tender amount, sufficient sums for the purchase of critical materials from any source available. After award of the contract, the Client will not grant increases to the tender amount to obtain critical materials at premium prices, nor will delays or interruption of the work be tolerated.

27. LAWS, CODES AND REGULATIONS

1. The tenderer is assumed to have made themselves familiar with and abide by the Federal National Authorities, Provincial, Municipal and local laws, rules and regulations which in any manner affect those engaged or employed in the work, or in any way affect the work, and no plea of misunderstanding will be considered on account of ignorance thereof. If the Bidder shall discover any provisions in the drawings, specifications or contract which are contrary to or inconsistent with any law, rule of regulation, Contractor shall at once report it to the architect in writing.

28. SITE ACCESS

1. Contractor to remove all debris from site daily.

2. Location of all trailers, storage units, and construction fences by contractor shall be reviewed and approved by the Client and Architect at a preliminary site meeting prior to contractor moving on to site.
3. Parking for construction workers shall be on site as directed by the General Contractor, only when parking spaces are available.
4. Site access for construction to be confirmed at first site meeting.

29. CONSTRUCTION SAFETY

1. Safety measures or procedures taken by the Contractor, i.e. site safety meetings, protective street hoarding, site construction fences, etc. will not relieve the contractor of their responsibilities for the safety of persons and property, and for compliance with the federal, provincial and local statutes, rules, regulations and orders applicable to the conduct of the work.
2. This Contractor shall be liable for any costs, fines, penalties, etc. levelled against the Client or Consultant due to violation of the Construction Safety Act by this Contractor or any Subcontractors on this project.
3. This Contractor will be responsible for submitting to the Client their safety program used in ongoing operation of their company and any safety recommendations specifically relating to the tendered project. This shall include provision of safe exit paths from the adjacent existing municipal building during construction.

30. PROJECT SCHEDULE

1. The successful bidder will be required to forward to the Architect, a schedule indicating construction sequences, manpower and equipment required in order to complete the work. This schedule is to be posted on site at all times. Schedule is to be updated on a weekly basis.
2. When the Architect deems that the Contractor's work has fallen behind schedule, the contractor will provide the necessary manpower and work the necessary overtime to bring the work back on schedule at no cost to the Client.
3. Contractor shall commence shop drawings immediately once acceptance of tender has been given by the Client. A complete shop drawing and sample submission schedule is to be provided within seven days of tender award. This will be reviewed by Architect.
4. Commence construction on the Project as soon as Building Permit is obtained.

31. MATERIALS AND EQUIPMENT

1. All materials and equipment supplied for the work shall be new, of the best quality, and in accordance with the latest applicable specifications of the Canadian Standards Association.

2. The particular method, material, procedure or equipment specified in this tender shall be used as a standard.
3. M.S.P.S. (Material Safety Data Sheets) for all materials being used on this project are to be kept on site and made available for use by all concerned.
4. Controlled substances: the use of any controlled substance of any kind must be reviewed by Client and written acceptance of its use obtained.
5. A bidder may submit an alternative method, material, procedure or equipment to that specified in the tender specifications. All alternatives shall be equal or superior to the standard specified in these tender documents and all unit prices along with overall product quantity cost is to be submitted. Alternates may not necessarily be accepted by the Architect.

Where particular products are specified and approved alternate manufacturers are listed, it is the responsibility of the contractor to ensure that any products carried in their tender from one of the approved manufacturer's meets or exceeds the original specified product.

Upon the alternate product shop drawing submission to the architect for review, all product data sheets (for specified and alternates) comparing the two products are to be submitted.

6. The bidder who furnishes an alternative method, material, procedure or equipment in place of the standard item specified shall furnish complete documented data including such information as chemical content and performance under laboratory tests which proves the quality and equality of the proposed alternative. This information shall accompany the bid. Note that the bidder who furnishes an alternative method, material, procedure or equipment in place of the standard item specified is responsible that the alternative will work with the Architectural layout, equipment will fit in the provided space and any revisions that will be required will be at the bidder's cost.
7. In all cases where alternative methods, materials, procedures or equipment are offered in response to this tender, the Owner shall make the final ruling on their acceptability.
8. During and upon completion of the work, the Contractor shall remove from the premises all surplus materials, equipment and debris.
9. The requirements of sentence 1 to 8 above shall also be applicable to any alternate material or method proposed or carried out during construction and the Contractor shall be responsible for all work related to the coordination of the alternate material or method with any other affected work of the contract including any additional work which may be required at no cost to the Owner.

32. ACCESS TO INFORMATION

1. All tenders, quotes and proposals are subject to the Municipal Freedom of Information and Protection of Privacy Act and will be disclosed where the Owner is required to do so for the purposes of complying with an Order of the Information and Privacy Commissioner.

33. GENERAL NOTES TO CONTRACTOR

1. The contractor will be required to keep and maintain a set of as-built drawings for each project. These drawings will be used for no other purpose than recording the exact location of buried or covered services and all changes to the contract documents. The as-built drawings will be submitted to the Architect along with guarantees, maintenance data, extra supplies, etc. at the substantial performance of the contract.
2. The contractor will turn over to the Architect at the completion of the contract all **project close out documents, as-built drawings, material, etc.** These documents, material, etc. including occupancy permit, will be accepted only with a transmittal and at no other time than when submitting a written request for substantial performance of the contract. For purposes of determining a value of this work it will be considered as **\$10,000.**
3. The contractor is not to act on verbal instruction from the Client, Consultants, or Architect on work they consider to be extra to their contract scope. Extra work can only be authorized by the Architect and in a written form only. The written form must also include that this work is an extra to the contract scope, and the method by which extra costs will be tabulated.
4. Work shall be done in accordance with best standard practice, unless special methods or performance standards are specified or given in writing by the Client. Only skilled mechanics shall be used where such are required to produce a first class job. Where required by code or other by-laws and regulations, trades people shall be licensed in their trades.
5. Use, install and handle manufactured materials in accordance with manufacturer's instructions.
6. Any work not acceptable to the Architect or Client or local authorities shall be removed and replaced when and as directed by them. The cost of re-executing such work shall be borne by the Contractor.
7. All mechanical maintenance pads and penetrations to be by Division 15, and all electrical maintenance pads and penetrations to be by Division 16.
8. The contractor shall have internet service (wifi) on the jobsite and shall maintain this service until the date of substantial performance of the contract.
9. The contractor shall maintain access to the buildings and portable buildings on site and shall restrict access to construction areas.

10. The contractor shall provide temporary drainage as required at construction access points to prevent the build-up of dirt and mud and the migration of this onto municipal streets. Periodic cleaning of municipal streets is to be provided when required and whenever specifically requested by the municipality.

END OF SECTION

1. EXAMINATION

1. Throughout the project, examine the work of all trades and promptly notify the Architect if any conditions do not or will not comply with the drawings and specifications.
2. **Note: The existing Library, Theatre and Civic Centre will remain operational throughout the duration of this Contract. Take special care to coordinate with the operators of these facilities for special temporary exiting measures and protections required.**
3. **The Theatre has two emergency exits which egress directly into and through the construction area. Provide all required hoarding, fencing, signage and protection to maintain these exits for the duration of the Contract.**
4. **The Civic Centre has one emergency exit directly adjacent to the northwest corner of the construction area. Provide all required hoarding, fencing, signage and protection to maintain these exits for the duration of the Contract.**
5. **The existing Fire Station being demolished under this Contract is affixed to the existing Theatre and Civic Centre. Take special care to minimize damage to the existing buildings during both demolition and construction Work.**

2. SETTING OUT

1. Lay out work from control benchmarks and verified reference points. The General Contractor shall have a qualified land surveyor, registered to practice in Province of Ontario, verify accuracy of layout and certify that building foundations and finish grade levels and locations are in accordance with the contract documents. File certification with Building Department and Architect immediately after foundations are completed. Payment for the Land Surveyor will be carried out by the General Contractor not under the Cash Allowance.
2. The Land Surveyor, retained by the General Contractor, shall provide four lines and one benchmark for the General Contractor to layout their work to. The General Contractor will provide these layout lines and benchmarks for work on all other areas once they begin work on the site.
3. Protect and preserve benchmarks and reference points. Inform Consultant immediately if bench marks or reference points are disturbed or damaged by any work and pay for their repair and/or replacement.
4. Locate and fix grid lines and locations of walls, partitions, shafts and all parts of the construction as work proceeds.
5. Verify grades, lines, levels and dimensions indicated, particularly with road and sidewalk elevation, and report any errors or inconsistencies to the Architect before commencing work. Confirm job dimensions at once to allow prompt checking of shop and other drawings.

3. PROTECTION

1. Conform to Ontario Building Code, latest amendments, and The Construction Health and Safety Act, all as currently amended.

2. Provide spare safety helmets for and enforce their use by Owner, Architect, their representatives and any authorized visitors to site.
3. Protect excavation, trenches, and buildings from damage by rain, water, ground water, backing up of drains or sewers and other water, frost and all other weather conditions. Do not allow footings or slabs to be placed on frozen ground. Do not permit excavations to reach full depth indicated when freezing temperature may be expected unless footings or slabs can be placed immediately after excavation has been completed. Protect excavations from frost by placing of suitable approved insulating material to adequate depth, if placing of concrete is delayed and after placing of concrete until backfilling occurs or freezing conditions terminate. Provide necessary pumps (including spare pumps) and temporary drainage for keeping project free of water throughout construction period. Pump water to public sewers or ditches by approved means. Refer to soils report. Control grading around excavations to prevent surface water from draining into excavation and from damaging adjoining property.
4. Protect building from movement and damage, especially during filling and compaction and until elements are securely anchored and cannot be damaged or moved by filling or compaction. Obtain approval of authorities having jurisdiction for such work and make changes as required by them.
5. Provide temporary construction fencing to enclose construction area, and pavement protection as required for protection of public, and of public and private property and as required by law and by authorities having jurisdiction. Maintain fences, gates until construction is complete. Keep free from unauthorized signs. See also Examination above regarding existing building to remain in operation and provide all required protection to minimize impact to those facilities.
6. Provide and maintain in working order, adequate, temporary Canadian Underwriters labelled, chemical solution (soda acid) Class A.1, fire extinguishers and locate in prominent positions to approval of authorities having jurisdiction.
7. Utilities and Services - Before starting the work contact the Public Utilities for location of all underground services.

4. AS BUILT DRAWINGS

1. Maintain as work progresses, accurate records of changes to the Drawings and concealed services. Accurate locations, depth, size, and type of underground utilities shall be included in these as built drawings. The General Contractor will be supplied with digital drawings in AutoCad®, 2016 or later and PDF format of the floor plans for making these recordings. As built drawings will be reviewed at each site meeting and must be properly maintained to receive Architect's approval before the monthly certificate draw will be approved.
2. Keep a daily record showing progress of the work and all factors affecting the work, i.e., weather, strikes, accidents, shipping delay, etc.
3. Completed as built drawings and instruction and warranty manuals shall be submitted prior to requesting substantial completion.

5. WASHROOM CONVENIENCES

1. General Contractor to provide washroom facilities as per the Construction Health and Safety Act for use of subcontractors and employees. Facilities shall be provided with a screen and contents shall be removed regularly during construction. Maintain it without offense to neighbourhood and adjacent public and private areas. At completion of building, washroom facilities and contents shall be removed and the ground carefully levelled and cleared. Employees on work must avail themselves of this convenience. It shall be to the satisfaction of local Health Authority.
2. Use of permanent toilets is forbidden.

6. TEMPORARY DRAINS

1. Excavations and building site shall be kept free from water at all times by means of trenches to sewers or pits from which it shall be pumped away and disposed from the site.

7. TEMPORARY WATER SERVICE

1. The General Contractor shall provide and pay for all temporary water and connections for water used for construction operations until the building is complete and turned over to the Owner. The Contractor will pay for the supply cost from the local municipality. Water for compaction and watering of sod shall be trucked to the site and paid for by the General Contractor.

8. TEMPORARY ELECTRICAL SERVICE

1. The General Contractor shall pay all temporary light and power necessary to the operations under this contract, including all connections necessary to supply to the Trade Contractors on site. The Contractor will pay for the cost of electrical power supply from the local P.U.C. utility only.

9. TEMPORARY HEATING

1. Provide temporary heat, heating equipment, and shelter, to keep that work which requires protection from cold, adequately warm and sheltered from elements and to allow it to be done safely and well, maintaining minimum temperature of 16 degrees Celsius (60 degrees F.) when finishing is being done and when building is closed in, until completion of work. Provide heating for materials affected by cold, both in storage and during construction. Construction requiring heat shall be suitably enclosed.
2. Do not use salamanders. Use temporary heaters of forced warm air type, operated in well-ventilated location and vented to exterior, or radiant panel type. If used in areas of completed building, provide protection on floors and adjacent surfaces to prevent damage to floors and adjacent surfaces, particularly when re-fuelling.
3. Provide temporary heat for interior spaces to maintain a minimum temperature of 16 degrees Celsius (60 degrees F.) throughout the building at all times once the

building is enclosed.

10. TEMPORARY USE OF PERMANENT HEATING SYSTEM

1. Permanent heating and ventilation system may be used for temporary heating and ventilation only if the Architect gives their approval to do so in writing, and when piping is complete, all units are connected, all pumps and valves are installed and operating properly, all strainers are installed and permanent or temporary filters are installed, and entire system has been tested and is safe operating condition, and when no further shut-down of system will be necessary for future conditions.
2. Do not use air distribution system until permanent or temporary filters are in place. Filter air distribution system to prevent dirt and dust from entering units via return air. Keep unused ducts sealed to prevent entry of air. Replace or clean filters frequently during construction to minimize entry of dirt. Clean (if cleanable) or replace filters before turning over system to Owner.
3. Put system in charge of fully trained and experienced operator at all times. If required, operators shall be selected jointly by Owner and Contractor with a view to permanent employment by Owner upon completion. Operators shall qualify as set out in Operating Engineers Act, if applicable.
4. Clean, maintain and repair heating and ventilation system as require throughout its use during construction. Notify manufacturer and Architect immediately before turning over new heating equipment to Owner so that heating items may be checked for possible damage during temporary heating period. Make good damage to heating and air distribution equipment. Replace all worn parts and turn over system to Owner in clean, new condition, operating with circulating water properly treated chemically.
5. Permission might be given by the Architect in writing only upon 100% operation completeness of the systems. Neither the Owner nor the Architect are under any obligation to grant permission to use permanent heating system during construction period.

11. TEMPORARY SERVICE ROADS

1. The Contractor shall construct and maintain in good condition, such temporary service roads, culverts that may be necessary to provide safe, convenient and adequate access for materials, and other supplies at all times while the General Contractor is working on site. NOTE: The Contractor shall protect existing roads, sidewalks, curbs and provide mud mats to the satisfaction of the Local Authorities and replace any that become damaged due to any operations under this contract. Contractor to clean all existing roads or streets where soiled by vehicles leaving the site.

12. DELIVERY AND STORAGE OF MATERIALS

1. Arrange for early deliveries necessary for execution of work without delay and have materials on job well in advance of the time it is needed.
2. Deliver, store and handle materials to exclude foreign material and prevent damage, soiling or breakage.

3. Materials to be stored on site, which need to be protected from weather shall be so protected.
4. Packaged materials shall be delivered in packages with manufacturer's seals and all labels intact.

13. BUILDING AND PREMISES

1. Owner reserves right to take over any completed portion prior to specified completion date, provided it does not affect completion of remaining work.
2. If Owner is forced to occupy building or parts thereof prior to completion, but after date of Substantial Performance, Contractor shall not be entitled to indemnity for interference with the performance of the work.

14. OWNERSHIP OF MATERIALS

1. All work or material delivered on the site or premises to form part of the works shall be considered the property of the Owner and shall not be removed without the consent of the Architect, but the Contractor shall have the right to and shall remove the surplus materials after he has completed the work. If so directed by the Architect, such surplus materials shall be removed at any time prior to the completion of the work.
2. All materials which are to be removed from the existing site and are not called for to be re-used or specifically called for in the specifications to be turned over to the Owner, shall become the property of the General Contractor and shall be removed from the site.

15. DETAILS AND MEASUREMENTS

1. Ensure that necessary job dimensions are taken and trades are coordinated for the proper execution of the work. Assume complete responsibility for the accuracy and completeness of such dimensions, and for co-ordination.
2. Verify that work, as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent work, as set out by requirements of the drawings, and ensure that work installed in error is rectified before construction continues.
3. Check and verify dimensions referring to work and interfacing of services. Dimensions, when pertaining to work of other trades, shall be verified with trade concerned.
4. Do not scale directly from the drawings. If there is ambiguity or lack of information, immediately inform the Consultant and await his instructions before proceeding. Be fully responsible for rectifying, altering or redoing any work resulting from disregarding this clause.
5. All details and measurements of any work which is to fit or to conform with work installed shall be taken at the site.

6. Should revised drawings be issued after work has commenced, Contractor shall immediately return to Architect previous drawings which refer to said work. The Contractor will be held responsible for work being carried out in accordance with said revised drawings.

16. WORKMANSHIP

1. Work shall be done in accordance with best standard practice. Only skilled mechanics shall be used where such are required to produce a first-class job.
2. Use, install and handle manufactured materials, equipment and appliances in strict accordance with manufacturer's directions and instructions, unless specified otherwise.

17. FROST PROTECTION

1. Provide proper frost protection, including heating for materials to ensure scheduling of work without delay.
2. Similar protection shall be given to work done.
3. Work or materials damaged by frost shall be replaced by Contractor.
4. Snow and ice shall not be allowed to remain on any part of structure, except finished roofs, and shall be removed by Contractor.

18. PROJECT MEETINGS

1. Arrange regular meetings at two week intervals and notify the representatives of the Owner, Architect, Engineer and each subcontractor concerned with the current progress.
2. Contact all subcontractors concerned at least 24 hours in advance and request their presence at job meeting.
3. Provide adequate internet connectivity for all parties attending meetings.
4. Provide required technology to allow virtual/remote attendance including large format monitor/screen (minimum 50 inches), webcam and microphone system adequate to pick up all voices in the room at normal speaking levels. All meetings shall include a virtual meeting invite on MS Teams or Zoom platform.
5. Review approved progress schedule for rapid and efficient completion of work according to Contract requirements, with suppliers of materials and sub-contractors.
6. Post and forward copies of progress schedule for advice of interested parties.
7. Record the minutes of each meeting and send copies to all attending and interested parties not later than two days after the meeting. In addition, send copies to the Architect, Consultants and Owner. Contractor to provide updated change order register and shop drawing register attached to each record of

minutes to indicate exactly what has been issued and the status of approvals and/or distribution.

8. Keep Architect informed of progress, delays and of potential delays during all stages of work to avoid delays.

19. BROKEN GLASS

1. Replace all broken, damaged or scratched glass and mirrors. Glass which has been broken, scratched or damaged in installation shall be replaced by installer.

20. TREE PROTECTION

1. Protect tops, trunks and roots of existing trees on project site that are to remain. Box, fence or otherwise protect trunks of existing trees which may be subject to construction damage before any work is started. Do not permit heavy equipment or stockpiles within branch spread. When approved, remove interfering branches without injury to trunks and cover scars with tree paint.
2. Wherever excavating is required within branch spread of trees that are to remain, do not cut tree roots, but tunnel or trench under or around roots by careful hand digging and without injury to roots.

21. MAINTENANCE MANUALS (Close-out Documents)

1. As soon as possible and in no event later than request for substantial completion check and assemble in three ring binder, all shop drawings, all warranties and guarantees submitted by manufacturers, suppliers and subcontractors and as called for throughout Specifications. Assemble three copies of recommended operation and maintenance procedures (such as flooring, equipment, roofing). Present three matching binders to Architect for submission to Owner. Furnish a complete index in each binder listing its contents in detail and stamp and sign the cover page of each and every manual. Also ensure that the manuals are stamped and signed on the cover page by subcontractor submitting them. Note: A **\$10,000.00 holdback** will only be released when all documents approved by the Consultants have been turned over to the Owner. This holdback shall be shown as a separate line item on the General Contractor's monthly invoice.
2. Recommended maintenance procedures shall contain warnings concerning the use of maintenance materials or practices which might injure the product covered by the recommended maintenance procedure. Should any product be injured or damaged by faulty maintenance or practices not warned against in the maintenance manual, then the Contractor shall rectify such damage or injury.
3. Complete maintenance manuals shall be submitted prior to requesting release of Holdback.

22. CHECK FLOOR DRAINS

1. Just before acceptance of building by Owner, check floor drains and see that they are clean, clear and functioning properly.

23. FIRE PROTECTION AND ACCESS TO EQUIPMENT AND EXITS

1. Take necessary precautions to eliminate fire hazards and to prevent damage to work, equipment and other property both public and private having to do with the work. Inspect work of this contract at least once a week for this purpose.
2. Provide and maintain in working order suitable Underwriters' labelled fire extinguishers and locate in prominent positions, to approval of authorities.
3. When welding, brazing and performing any operation with an open flame, a portable fire extinguisher shall be kept within 10 feet (3000 mm) of the operator at all times.
4. Store and locate materials and equipment packed in cardboard cartons, wood crates and other combustible containers in orderly and accessible manner. Place approved types of firefighting equipment in vicinity of materials or equipment packed in this type of crate or carton until permanent fire protection and equipment are available.
5. Store all rags and waste containing oil, grease or other flammable materials in an approved metal container and remove from the site at the end of each working day.
6. Only fire resistant tarpaulins are permitted on site.
7. Locate temporary buildings and storage areas in relation to their hazards and probability of damage to existing buildings under construction. Unless constructed of non-combustible materials, wherever possible locate them at least 33 feet (10 m) away from buildings. If constructed of combustible materials separate these structures into small detached units.
8. Provide and maintain free access at all times from the street to fire hydrants and to outside connections for standpipes or other fire extinguishing equipment whether permanent or temporary. Do not place material or construction equipment within 10 feet (3 m) of hydrants or connection, nor between them and centre line of the street.

Maintain free access at all times to control valves and hose on fire lines within building and to all portable extinguishers.
9. Install fire doors and put into operating condition at the earliest possible time.
10. Comply with requirements of 015450 Safety Requirements.

24. PROTECTION OF NEW AND EXISTING/ADJACENT BUILDINGS

1. **Note: The existing Library, Theatre and Civic Centre will remain operational throughout the duration of this Contract. Take special care to coordinate with the operators of these facilities for special temporary exiting measures and protections required.**

2. Particular attention shall be paid to prevention of fire and elimination of fire hazards which would endanger new work or existing property.
3. No existing footings, foundations, pipelines, electrical conduit and wiring shall be undermined or otherwise damaged or endangered by digging, butting of any other operation in the performance of the work of this Contract. Any existing work so affected shall be immediately repaired and made good to the Architect's satisfaction at the Contractor's expense.
4. Active services to the adjacent buildings shall be protected.
5. In case of damage to active services, notify Architect, Utilities and Authorities immediately and make all required repairs under direction of appropriate utility. Carry out repairs during off hours if required.

25. NOTES TO GENERAL CONTRACTOR

1. Ensure that the building is maintained weathertight and secure. The General Contractor shall furnish all temporary protection, enclosures, tarpaulins, etc., as may be required to weatherproof openings in the work.
2. Demolish and clean up all existing trees, scrub and debris and any other items found on the site not indicated to remain.
3. The General Contractor shall carry out all removal and disposal of all resultant debris.
4. In case of damage to active services, notify Architect, Utilities and authorities immediately and make all required repairs under direction of appropriate utility. Carry out repairs during off hours if required. In absence of specific requirements or direction, plug or cap unused or abandoned utility lines at least 3 feet (1000 mm) outside of new building walls, or as required by utilities, codes and authorities.
5. Restore disturbed areas to original condition unless shown otherwise on drawings or stated in specifications including provision of topsoil and seeding or sod to disturbed areas outside of the area of work.
6. Where site measurement of site conditions, openings and clearances is required by a Trade or supplier prior to preparation of shop drawings or ordering of materials, The Contractor shall ensure that such site conditions are completed and ready for measurement or verification by such Trade or supplier at a time which will allow the Trade or supplier sufficient time to deliver their work with no negative impact to the construction schedule.

26. CONSTRUCTION PARKING

1. Parking will be permitted on site provided it does not disrupt the performance of Work.

27. PROTECTION FOR OFF-SITE & PUBLIC PROPERTY

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

28. SIGN AND ADVERTISEMENTS

1. Erect no other signs, except those signs which are necessary to give direction or for safety, or warning signs, without the Architect's permission. Where other signs are required or wanted, obtain Architect's approval.

29. PROTECTION OF BUILDING FINISHES & EQUIPMENT

1. Provide protection for finished and partially finished building finishes and equipment during performance of work.
2. Provide necessary screens, covers, hoardings as required.
3. Be responsible for damage incurred due to lack of or improper protection. Replace or repair finishes or equipment so damaged.

30. SECURITY

1. Extent of security services shall be at the discretion of the Contractor. Note that the fit, finish and new appearance of the finished building will not be comprised. Materials, products, finishes, etc. damaged due to vandalism are to be restored and/or replaced to an as-new condition at no cost to the Owner. Should the Contractor determine that additional security measures be required beyond what was allowed for in the tender amount, such costs shall be borne solely by the Contractor.

End of Section

1. CASH ALLOWANCES

1. Include the following Cash Allowances in the Contract Price. These allowances shall be expended in whole or in part, when authorized by the Architect in writing. The unused portion of the Allowances shall be credited to the Owner.
2. The Contract Price and not the cash allowance, includes the Contractor's overhead and profit in connection with such cash allowance.

No refund of overhead and profit will be expected on any unspent portion of Cash Allowances. Likewise, no overhead and profit will be allowed on total amount by which all Cash Allowances are exceeded.

3. Expend cash allowance as directed by the Consultant in writing. Allowance will be adjusted to actual cost but no adjustment will be made to Contractor's charges including overhead and profit which are included in the Contract Price.
4. Cash allowances are designed for work and services deemed to be necessary by the Owner, from time to time, throughout the execution of the Work. Where a cash allowance refers to an item or category of work already included in the Contract Documents, it shall be assumed to cover work or services in addition to that included, unless specifically indicated otherwise.
5. Contractor may be required from time to time, to assist in tendering of certain items of work or services covered by allowance, as directed by Consultant.
6. Material Supply Items:

1. Scope for material supply items covered by Cash Allowance includes:
 1. Net cost of material.
 2. Applicable taxes and duties.
 3. Delivery to site.
2. In addition to above scope covered by Cash Allowance include in Contract Price costs for:
 1. Handling at site, including unloading, uncrating, storage and hoisting.
 2. Protection from elements, from damage.
 3. Labour, installation and finishing.
 4. Other expenses required to do cash allowance work (i.e. contract co-ordination).
 5. Overhead and Profit.

8. Material and Installation Items:

1. Scope of each material and installation item covered by Cash Allowance includes:
 1. Net cost of material.
 2. Applicable taxes and duties.
 3. Delivery to site.

4. Handling at site, including unloading, uncrating, storage and hoisting.
5. Labour, installation and finishing.
2. In addition to above scope covered by Cash Allowance include in Contract Price costs for:
 1. Protection from elements, from damage.
 2. Overhead and Profit.
 3. Other expenses required to do cash allowance work (i.e. contract co-ordination).
9. Inspection and Testing Work:
 1. Scope for inspecting and testing covered by Cash Allowance includes:
 1. Net cost of testing laboratory services and field inspection.
 2. In addition to above scope covered by Cash Allowance include in Contract Prices for:
 1. Overhead and Profit.
 2. Supply of material tested, patching and completion of work tested.
 3. Other testing on re-testing work specified in Section 01400.
 4. Other expenses required to do cash allowance work (i.e. contract co-ordination).
10. The following is a breakdown of the Cash Allowance Items **to be included** in the Contract Price:

NO.	ITEM	VALUE + HST
1	Door Hardware - supply only of hardware - installation is included in base bid Contract and is NOT a part of this allowance. - excluding cabinet hardware which is included in Section 06 41 00 Note: Automatic door operators and actuators are provided under Section 087150 and are NOT a part of this cash allowance.	\$120,000.00
2	Inspection and Testing • testing of compacted fill • other soils compaction testing • concrete inspection/testing • rebar inspection • structural steel inspection/testing • mortar testing • Roof Inspection (3rd party) • building envelope - air barrier, insulation, flashings	\$40,000.00

ALLOWANCES

3	Interior/Exterior Signage/Glazing Film - major and minor signage - room names/numbers - accessibility - door signage - bulkhead signage - supply and install - interior glazing film (vision strips, privacy) - traffic signage where not shown on drawings	\$40,000.00
4	Exterior Illuminated Ground Mounted Sign - Prefabricated box sign/graphics - Light from interior - Programmable message board/controls - including 4000mm high x 150mm dia. Painted steel pole & concrete base on compacted granular - All required wiring, control wiring	\$30,000.00
5	Exterior Illuminated Wall Mounted Sign - Prefabricated illuminated wall mounted sign with graphics - Electrical wiring & connections	\$10,000.00
6	Gas Service Connection • local utility charges related to gas service & meter	\$20,000.00
7	Main Electrical Service and Connections • supply and install of equipment and connections performed by Utility	\$60,000.00
8	Access Control Devices and Wiring • supply and install of access control devices and wiring/cabling/connection, programming, commissioning at all card reader locations. • Access control at doors throughout where indicated • Access control at sliding gate to rear parking • All conduit, boxes rough-in are included in base bid and NOT part of this cash allowance.	\$25,000.00
9	Security/CCTV/Monitoring Devices and Wiring • supply and install of security, CCTV cameras, monitors and other devices and wiring/cabling/connection, programming, commissioning at Detention area and interview rooms. • All conduit, boxes rough-in are included in base bid and NOT part of this cash allowance.	\$100,000.00
	Subtotal of Above Cash Allowances (Item 2.10) (Not Including Contingency Allowance) +HST	\$445,000.00

This above figure \$445,000.00 is to be included in the Base Bid Amount for cash allowances.

11. Progress payments on accounts of work authorized under cash allowances shall be included in the Consultant's monthly certificate for payment. Copies of invoices are to be submitted to substantiate claims.

END OF SECTION

1. GENERAL

1. REQUIREMENTS INCLUDED

1. Requirements and limitations for cutting and patching the Work.

2. SUBMITTALS

1. Submit written request in advance of cutting or alteration which affects:
 1. Structural integrity of any element of Project.
 2. Integrity of weather-exposed or moisture-resistant elements.
 3. Efficiency, maintenance, or safety of any operational element.
 4. Visual qualities of sight-exposed elements.
 5. Work of the Owner or separate contractor.
2. 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 the Owner or separate contractor.
 7. Written permission of affected separate contractor.
 8. Date and time work will be executed.

3. GENERAL

1. Execute all cutting, fitting, and patching including excavation and fill, required to complete the Work.
2. Fit the 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. Remove samples of installed work for testing if requested by Consultant.

6. Provide openings in non-structural elements of Work for penetrations of mechanical and electrical work.
7. Schedule and coordinate Work to minimize cutting and patching.
8. Cut, patch and make good to accommodate Work and to leave Work in finished condition. Cutting in this sense shall mean actual cutting of components to allow new components to pass through or to provide new openings. Cutting shall not mean mere drilling of holes to accommodate screws, anchors, bolts or other fasteners as such. Such drilling is part of Section's installation function.
9. Use workers qualified in work being cut and patched to ensure that it is correctly done.
10. Do not cut, drill or sleeve load-bearing members without obtaining written approval for each condition.
11. Cut holes carefully, leaving clean holes no larger than required, after they are located by Sections requiring them.
12. Make cuts with clean, true, smooth edges to tolerances required and in conformance with industry practice for applicable class of work. Make patches undetectable in finished work.
13. Responsibility for various categories of cutting and patching shall be as follows:
 1. Cutting and patching of architectural and structural Work required for installation of work of Divisions 23 and 26:
 2. Holes and openings up to 200 mm (8") in diameter and related patching by applicable Sections of Divisions 23 and 26;
 3. Holes and openings larger than 200 mm (8") in diameter, chases, removal of existing bulkheads and furring (if any) and related patching by Contractor. Be responsible for any additional cost incurred as a result of over sizing of openings during cutting and patching operation of openings to be fire stopped.
 4. Cutting and patching of architectural and structural work required by Sections other than those of Divisions 15 and 16 is responsibility of Section whose work is to be cut or patched.

4. **INSPECTION**

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.

5. PREPARATION

1. Provide supports to assure structural integrity of surroundings; devices and methods to protect other portions of project from damage.
2. Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

6. PERFORMANCE

1. Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.
2. Use material to match existing.
3. Employ qualified trade contractor to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight exposed surfaces.
4. Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed without prior approval.
5. Restore work with new products in accordance with requirements of Contract Documents.
6. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
7. Refinish surfaces to match adjacent finishes: For continuous surfaces refinish to nearest intersection.

End of Section

1 SUMMARY

1.1 General

1.1.1 This Division governs Work of all other Sections. Sections of Division 1 are complementary and shall be read together with others.

1.2 Contract Documents

1.2.1 The Work shall be performed under one Contract utilizing the Canadian Construction Document CCDC 2, 2020– Stipulated Price Contract. The Contract and the Supplementary Conditions shall govern the performance of each Section of the Specifications

1.3 Specification Format

1.3.1 Specifications are not intended as detailed description of installation methods but serve to indicate particular requirements in completed Work.

1.3.2 Where Contract Documents do not provide sufficient information for complete installation of item, then as supplement, comply with manufacturer's written instructions for quality of work.

1.3.3 Portions of Specifications are written in short form. Therefore, it shall be understood that where item of Work is stated in heading followed by material, equipment, component, or operation, words "shall be", "shall consist of" or similar words or phrases are implied which denote supply, fabricate and supply, install, provide or commission of such materials, equipment or operations for component of Work designated by heading.

1.3.4 Where items in Contract Documents are referred to in singular provide as many as required to complete Work. Words used in one gender only shall mean females and as well as males and conversely.

1.3.5 Whenever used in Specifications following definitions shall apply:

1.3.5.1 Supply - Procurement or fabrication of standard components not to special design of materials, equipment, or components, or performance of services to extent indicated. Where used with respect to materials, equipment, or components, term shall include delivery to Site but is not intended to include installation of item, either temporary or final.

1.3.5.2 Fabricate and Supply - Fabrication of materials, equipment, or component, to special customized design to extent indicated including delivery to Site, assisting in form of supervision to those Section(s) installing materials, equipment or component. Term does not include installation of item either temporary or final.

1.3.5.3 Install - Placement of materials, equipment, or components, including receiving, unloading, transporting, storage, uncrating and installing, and performance of such testing and finish work as is compatible with degree of installation specified complete ready for use.

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- 1.3.5.4 Provide - To Supply and install complete and in place, including accessories, finishes, tests and services as required to render item so specified complete ready for use.
- 1.3.5.5 Commission - Startup and initial operation of equipment as required and/or as specified in respective Sections, to demonstrate satisfactory operation of components and entire system including calibration of any control instrumentation as required to maintain operations.
- 1.4 Drawings, Lists or Schedules of Items are intended to show scope and arrangement of work. For location of item described refer to such Drawings, Lists or Schedules unless location stipulated in Specifications.
- 1.5 **Discrepancies/Conflicts/Omissions**
- 1.5.1 If discrepancies or conflicts in, or omissions from Drawings, Specifications or other Contract Documents are suspected, or if there is doubt as to meaning or intent thereof, notify the Consultant at once. Where there is conflict between Contract Documents, stringent requirements shall prevail.
- 1.5.2 Drawings, Specifications and other Contract Documents are intended to be in compliance with federal, provincial and municipal laws, by-laws, regulations and other requirements of authorities having jurisdiction. Perform work in conformity with such requirements. If discrepancies, conflicts or omissions are suspected, notify the Consultant at once.
- 1.5.3 Comply with the Consultant's written instructions or explanations.
- 1.5.4 Contractor shall promptly, and not later than ten (10) working days of becoming aware of circumstances which may require a change in the Work or other directions, give written notice to the Consultant outlining such circumstances and requesting written directions. Do no work in affected area, or that would prevent Consultant from properly assessing situation or evaluating change, without prior written approval. The Consultant will act promptly to give Contractor directions so Work is not unreasonably delayed.
- 2 **SUMMARY OF WORK**
- 2.1 **Work covered under this Contract**
- 2.2 Work of this Contract includes furnishing labour, materials, equipment, services, and other related expenses to execute complete demolition and construction of facility specified under Contract Documents.
- 2.3 Work covered under this contract includes but not limited to the following:
- 2.3.1 Demolition of the existing Fire Station.
- 2.3.2 Construction of Hanover Police Services Building.
- 2.3.3 The work includes all site work, architectural, landscaping, civil, structural, mechanical and electrical engineering.

2.4 In accepting award of this Contract, Contractor hereby reaffirms that it is fully informed regarding all conditions affecting Work and further accepts to complete Work for purpose intended in accordance with Contract Documents. Contractor hereby reaffirms that it does not and will not have any conflict of interest in executing work of this Contract.

2.5 Work Provided or Performed Under Separate Contracts

2.5.1 Term "NIC" means that work of this Project, which is not being performed or provided under this Contract; term means "Not In this Contract" or "Not a Part of the Work to be Performed or Provided by Contractor."

2.5.2 "NIC" work may be specified or indicated on Drawings as an aid to Contractor in scheduling amount of time and materials necessary for completion of Contract.

3 WORK RESTRICTIONS

3.1 Inclement Weather And Cold Weather Work

3.1.1 Take precautions during inclement weather and provide adequate protection to Work and construction materials from damage.

3.1.2 Continue Work including winter months, if applicable, until Work is completed and accepted.

3.1.3 Inclement weather or extra work caused thereby shall not be considered valid reason for additional payment or delay in satisfactory conclusion of Work.

3.2 Access To Site

3.2.1 Work shall be confined to Work Site limits indicated on Drawings

3.2.2 Assume responsibility for care, custody and control of Site and perform work to extent covered in Contract Documents. Make good damage to existing Site and existing buildings due to Work of this Contract.

End of Section

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1. See Individual Specifications Sections for full listing of inspections and approvals.
 2. Architect's approvals required:
 1. Architect's and Consultant's approval before interfering with existing services and apparatus. One week notice to be given. Section 010100.
 2. Architect's approval of work schedule (Progress Schedule) - 013100.
 3. Architect's and Consultant's approval of substitutions - 015000.
 4. Consultant's approval of footing bearing soil compaction.
 5. Consultant's approval of compaction.
 6. Consultant's approval of cast-in-place concrete materials, admixtures and tests.
 7. Architect's approval of Masonry Sample Wall.
 3. Notify Architect:
 1. Notify Architect and Roof Inspection Consultant 7 days in advance before commencing roofing.
 2. Notify Architect for Deficiency Inspection upon agreed Substantial Performance.
 3. Notify Architect for Two-Year Warranty Holdback Inspection.
 4. Notify Client for Two-Year Roofing Inspection for Extended Warranties
 5. Notify Client for Two Year Inspection of Extended Warranties
 6. Notify Client for Three Year Inspection of Extended Warranties
 7. Notify Client for Five Year Inspection for Extended Warranties
 8. Notify Client for Ten Year Inspection for Extended Warranties.
 4. Submit samples for approval.

End of Section

1. PROGRESS PHOTOGRAPHS

1.1 Take total of eight (8) colour photographs once a week of progress of the Work. Submit photographs with each monthly draw request to the Architect.

1.3 Progress Photos to be taken by General Contractor.

2. PROFESSIONAL PHOTOGRAPHS

2.1 Prior to the Release of Deficiency Holdback, the General Contractor shall arrange for a professional photographer to provide a minimum of 20 photographs in both raw format as well as in digital high-resolution TIFF and JPEG format (min. 10MP) to the Client and the Architect.

2.2 Submit proposed accredited photographer to the Architect for review and acceptance.

END OF SECTION

1. CONSTRUCTION SIGNAGE AND ADVERTISEMENTS

- 1.2 Erect no other signs, except those signs which are necessary to give direction or for safety, or warning signs, without the Architect's permission. Where other signs are required or wanted, obtain Architect's approval.

END OF SECTION

1. INTERFERENCE DRAWINGS

- 1.1 Before commencing any work, the General Contractor, along with their trade contractors, are to prepare working / interference drawings, to ensure that all components are to be properly accommodated within the spaces provided, ensuring all clearances required by jurisdictional authorities and for proper maintenance are indicated and maintained.
- 1.2 Schedule meetings on site with all associated trades to review all interference areas until all issues have been coordinated and required interference drawings issued.
- 1.3 Prepare drawings to indicate coordination and method of installation of a mechanical system with electrical, structural and other systems where their relationship is critical. Ensure all details of equipment, apparatus and connections are coordinated.
- 1.4 The General Contractor shall provide interference drawings prepared by their Mechanical and Electrical subtrades. Drawings are to be red-line markups scanned to PDF Format and shall indicate any perceived interference between mechanical, structural, and electrical work and the work of all other Divisions along with proposed solution to such interference.
- 1.5 Failure to coordinate with all other trades could result in reworking of installed equipment, piping or ducting at the discretion of the Consultant. Any reworking to accommodate the installation of other trades is to be performed at no extra cost.
- 1.6 All interference drawings shall be submitted and approved prior to the second Certificate of Payment being released.

2. COOPERATION AND COORDINATION

- 2.1 Cooperate and coordinate with other trades as required, for satisfactory and expeditious completion of work. Take field dimensions relative to work. Fabricate and erect work to suit field dimensions and field conditions. Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to, or inserted in work, and set in place or instruct related trades as to their location. Pay cost of extra work caused by and make up time lost, as a result of failure to provide inadequate time, the necessary cooperative information of items to be fixed to, or built in.

END OF SECTION

1. GENERAL

1. GENERAL

1. This section details General Contractor's responsibilities in preparation, submission and maintenance of construction schedules with form and requirements for periodic revisions. The Sub-Contractors shall provide the General Contractor with their schedule of work and co-ordinate the work with General Contractor and the Work Progress of other trades on site.
2. The General Contractor shall be solely responsible for taking any corrective action required to make-up for any delays.

2. REQUIREMENTS INCLUDE

1. Schedule, form, content.
2. Stages/Phased Construction.
3. Schedule Revisions.
4. Weekly schedule updating.

3. SCHEDULES REQUIRED

1. Submit the following schedules:
 1. Construction Progress Schedule.
 2. Weekly Schedule and Manpower Loading.
 3. Submittal Schedule for Shop Drawings and Product Data.
 4. Product Delivery Schedule. Include required decision dates for finishes and colours.
 5. Sub-schedule showing submittals, review times, procurement schedules, and delivery dates.
 6. Sub-schedules to define critical portions of overall schedule.

4. FORMS OF SCHEDULES

1. Prepare schedules in form of horizontal bar chart (GANn, or C.P.M. network. Provide separate horizontal bar column for each trade or operation, or separate activity for each operation that can be completed independently of other operations or trades. Provide as follows:
 1. Order: Chronological order of beginning of each item of work.

2. Identification: Identify each column by distinct graphic delineation.
3. Horizontal Time Scale: Identify first work day of each week.
4. Scale and Spacing: To allow space for updating.
5. Minimum Sheet Size: 11" x 17" for electronic submission.

5. SUBMITTALS SCHEDULE

1. Include schedule for submitting shop drawings, product data, and samples. Co-ordinate with section 01300 requirements. Incorporate into Preliminary Progress Schedule and Weekly Schedule updates.
2. Indicate dates for submitting, review time, resubmission time, float time, and last date for meeting fabrication schedule.
3. Include dates when SUBMITTALS and delivery will be required for the Owner-furnished products if applicable.
4. Include dates when reviewed submittals will be required from the Consultant.

6. PRODUCT DELIVERY SCHEDULE

1. Include dates for delivery of products specified in Section 01020 - Allowances, if applicable.
2. Include dates for products furnished by Owner, if applicable.
3. Submit a schedule of required equipment order dates and delivery dates for products and/or assemblies which involve insignificant production time or fabrication time and/or will significantly affect the project schedule if not available when needed.

7. CONSTRUCTION PROGRESS SCHEDULE

1. Submit a preliminary construction schedule and phasing plan upon notification of bid acceptance or award of contract, for approval.
2. Incorporate approved preliminary schedule in construction schedule specified in GC 3.5 of The General Conditions of The Stipulated Price Contract.
3. Schedule must be submitted within a minimum of seven (7) days before first progress application for payment. Prepare schedule in sufficient detail to indicate timing of major activities during phased progress of the Work and which will ensure completion of the Work on or before schedule.
4. On schedule indicate a time bar for each major construction activity to

be performed at the site, properly sequenced and co-ordinate with other activities of work. Itemize activities in sufficient detail that no one bar exceeds two months in duration (separate long running trades such as Masonry into Logical Sub-Sections). Allow sufficient space below planned time bar for another time bar to record actual progress.

5. Show dates for commencement and completion of all activities. Estimate duration period and float (contingency) time for each activity.
 6. Show projected percentage of completion for each activity as of the date of submission of monthly progress payment applications and/or to the date of submission of schedule when requested.
 7. Indicate actual progress of each activity to date of submission of schedule. Indicate current status of all activities to date of submissions of schedule by showing where behind, on or ahead of planned schedule.
 8. Show changes occurring since previous submission of schedules:
 1. Major changes to scope
 2. Activities modified since previous submission
 3. Revised projections of progress and completion
 4. Other identifiable changes.
 9. Confirm commencement, duration and completion dates of all activities with subcontractors, subtrades and suppliers.
 10. Deliver to Architect, at the end of each calendar month with progress application a project status report derived from evaluation of Schedule.
 11. Include in this report updated schedule together with such supporting narrative and such graphical presentations necessary to clearly outline the progress of Work, areas of current and anticipated problems, effect of changes on schedules of major trade subcontractors and proposed corrective action.
 12. Lengthy shutdowns and disruptions of services will not be tolerated, and strict attention shall be paid to minimizing any disruption.
8. STAGED/PHASE CONSTRUCTION (if required)
1. Prepare and submit sub-schedules for each separate stage of Work when pertinent to the project.
 2. Provide sub-schedules to define critical portions of prime concern to master schedule.

3. Describe start and stop, float time and affected other work.

9. WEEKLY SCHEDULE UPDATE AND MANPOWER LOADING

1. Use the Construction Progress Schedule as a basis for reporting on a weekly basis the complete status of construction progress, scheduled activities and manpower loading on the project.
2. There will be an Owner/Architect/Consultant/General Contractor/Trade Contractor meeting every second week to review the project status. Provide a detailed 2 week work schedule (based upon the Construction Progress Schedule) outlining work activities and manpower requirements planned for that period.
3. Identify current and anticipated problems and delays with respect to the past work period the effects of said problems on the overall schedule and proposed corrective measures.
4. Submit to Architect two days prior to site meetings (every second week) the following:
 1. Updated Construction Progress Schedule.
 2. Outline of anticipated work activities for the forthcoming period.
 3. Outline of required and/or anticipated manpower levels (by trade) for the forthcoming period.
 4. Problems or delays experienced and/or anticipated.
 5. Proposed corrective measures to react to problems or delays.

END OF SECTION

1. SHOP DRAWINGS

1. Submit shop drawings electronically in PDF format as per Architect's Contract Administration System Software 018050, in accordance with CCDC Document 2, 2020 and the Supplementary General Conditions, as required in various sections of these specifications and on the drawings.
2. Review submittals prior to submission. This review represents that all necessary requirements have been determined and verified, and that each submittal has been checked and coordinated with requirements of the Work and Contract Documents. Submittals not stamped, signed, dated by the General Contractor and identified as to specific project will be returned without being examined and considered rejected.
3. Notify, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
4. Verify field measurements and affected adjacent Work are coordinated.
5. Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
6. Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
7. Keep one reviewed copy of each submission on site.
8. The Contractor shall be responsible for:
 1. notifying the Consultant in writing of changes made to shop drawings from Drawings and Specifications;
 2. changes made from Drawings and Specifications not covered by written notification to the Consultant;
 3. making any changes in the shop drawings which the Consultant may require consistent with the Contract Documents;
 4. submitting copies of revised shop drawings to the Consultant;
 5. errors and omissions in the shop drawings;
 6. meeting requirements of the Contract Documents;
 7. confirmation of dimension and correlation at the job site;
 8. co-ordination of dimension and correlation at the job site;
 9. any conflicts between Subcontractors as a result of lack of comparison and co-ordination of shop drawings of the work affected trades;

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10. signifying, checking and approving of all submissions, by stamping with company stamp and signature by responsible company official.
 9. The Consultant shall review the shop drawings for the sole purpose of ascertaining conformity with the general design concept and for general arrangement.
 10. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings and shall not relieve the Contractor of his responsibilities.
 11. Review of the shop drawings by the Consultant does not authorize changes in cost or time.
2. SAMPLES
1. Submit samples as outlined in the respective specification sections.
 2. Samples of materials, both manufactured and otherwise, proposed for the use on the work shall be submitted to the Architect for approval as required by the Contract Document and/or reasonably required by the Architect. The work shall be in accordance with approved samples. All samples shall be supplied and delivered to the Architect free of charge. The approval of samples shall not be construed as an acceptance of work subsequently carried out.
 3. Samples shall be labelled indicating: date of submission, name of project, names of contractor and manufacturer, and complete identification of locations at which materials are to be installed.
3. EXTRA MATERIAL
1. Submit extra material as follows:

Masonry	As specified
Flooring	2% of total area of each type & finish
Acoustical Ceiling Tile	1% of each type
Paint	1 Gallon each colour
4. CERTIFICATE FOR PAYMENT APPLICATION
1. Refer to below sample format for application for certificate of payment (schedule of values).

CERTIFICATE OF PAYMENT APPLICATION FORM

NOTE: HST TO BE EXCLUDED FROM EACH OF THE FOLLOWING VALUES:

Contractor: _____

Application No. _____

Work: _____

Date: _____

Period Covered: _____

Description	Contract Amount	% To Date	Value Performed To Date	Value Previously Performed	Value Current Period	Balance to Complete
This Section to show breakdown of Contract such details as:						
General Conditions	\$	\$	\$		\$	\$
Excavation						
Concrete Footings						
Concrete Walls, Cash Allowances, Hardware, etc.						
SUB-TOTAL						
Change Orders No. 1 No. 2 No. 3						
TOTAL CONTRACT						

SUMMARY (HST to be excluded from all items)

Value of Work Completed to date \$ _____

Less Holdback of 10% \$ _____

Holdback Released \$ _____

Current Holdback (Net Retained) \$ _____

Sub-Total \$ _____

Less Previous Certificates \$ _____

Amount of this Claim \$ _____

H.ST.(\$ _____)

GENERAL CONTRACTOR'S H.S.T. NO. _____

1. GENERAL

1. GENERAL REQUIREMENTS

1. Division One - General Requirements is a part of this Section and shall apply as if repeated here.

2. PAYMENT OF INSPECTION COMPANIES

1. The cost of inspection and testing will be paid out of an allowance provided under Section 01 02 00, except where tests or inspections reveal work not in accordance with the Contract, the Contractor shall bear the cost of such tests and additional tests as the Architect requires to verify the acceptability of corrected work.
2. Refer to Cash Allowance Section 01 02 00 for list of required inspection and testing services.

3. RESPONSIBILITIES

1. The Contractor shall advise the Architect and the respective Inspection and Testing authority not less than 5 working days prior to the commencement of any work to be inspected or tested and ensure that proper facilities and co-operation is provided and that no work is carried out without the required inspection and testing.
2. Proper storage shall be provided for storing concrete specimens at the job site at the required temperature and free from vibration or injury.

END OF SECTION

1. ACCEPTABLE PRODUCTS

1. First item named or specified by catalogue number meets specifications in all respects regarding performance, quality of material and workmanship, and is acceptable to the Architect.
2. Items, other than first named, meeting specifications regarding quality of materials and workmanship only, are acceptable to the Architect, if they also meet performance, match the first named product in colour and texture, etc. and/or capacities specified and can be accommodated within the space allotted.
3. General approval indicated by inclusion of other manufacturers named is subject to final review of submitted samples of shop drawings, performance data and test reports.
4. Where the contractor uses equivalent products other than that first named, on which design is based, the contractor shall be responsible for all details of installation including product size, arrangement, fit, colour, etc. 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 may be considered indication that additional costs associated with equivalent products such as revisions to surrounding architectural finishes, structural components, or the need for larger motor starters, larger power feeders, space revisions to associated product equipment, controls, etc. shall be included in Bid price.

2. APPROVAL REQUIRED

1. The Contract is based on the materials, equipment, and methods described in the Contract Documents.
2. The Architect will consider proposals for substitution of materials, equipment, and methods only when such proposals are accompanied by full and complete technical data and all other information required by the Architect to evaluate the proposed substitution.
3. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved for this work by the Architect, in writing.
4. Submit for review and approval full product characteristics comparison chart outlining the spec product and the proposed substitution product with indication if it meets or exceeds or is below the specified standard. This shall include but not limited to: all product characteristics, material testing and manufacturing standards references, dimensional differences, color availability variations.

3. "OR EQUAL"

1. Where the phrase "or equal", "approved equal", or "equal as approved by the Architect" occurs in the Contract Documents, do not assume that materials,

equipment, or methods will be approved by the Architect.

2. The decision of the Architect shall be final.

4. AVAILABILITY OF SPECIFIED ITEMS

1. Verify prior to bidding that all specified items will be available in time for installation during orderly and timely progress of the work.
2. In the event specified items will not be available, notify the Architect prior to receipt of bids.
3. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

END OF SECTION

1. GENERAL

1. REQUIREMENTS INCLUDED

1. Safety measures
2. Fire protection
3. Overloading precautions
4. Falsework
5. Scaffolding

2. CONSTRUCTION SAFETY MEASURES

1. Observe and enforce construction safety measures required by National Building Code (Part 8) and Ontario Building Code (latest edition as currently amended), Provincial Government, Workplace Safety & Insurance Board and municipal statutes and authorities.
2. In particular, the Ontario Construction Safety Act, the regulations of the Ontario Department of Labour and Ontario Hydro Safety Requirements shall be strictly enforced.
3. In the event of conflict between any provisions of above authorities the most stringent provisions will apply.

3. MATERIAL SAFETY DATA SHEETS

1. Submit Material Safety Data Sheets (MSDS) for any product to be used, installed or applied inside of the building if said product may emit toxic fumes and/or noxious odours.
2. Submit Material Safety Data Sheets for any product which is known to or suspected of creating a health hazard or discomfort when used in confined spaces, including but not limited to the following:
 1. Adhesives
 2. Solvents
 3. Sealants (Caulking, etc.)
 4. Other products which may give off air borne particles after installation
 5. Any other product as direct by Architect/Consultants.
3. The required Material Safety Data Sheets to be submitted prior to ordering

material or product for use as a part of the Work

4. The Owner may withhold payment for work of a subtrade or section until MSD Sheets for products supplied by that subtrade or section have been submitted, reviewed by Consultant and found to be acceptable.
5. Refer to Section 01700 - Project Close-Out for requirements regarding Certificates of Compliance.

4. MATERIALS SPECIFICALLY EXCLUDED

1. Asbestos and/or asbestos - containing products are not permitted. Submit Material Safety Data Sheets for any product suspected of containing asbestos if so requested by Consultant. Examples of some materials requiring close scrutiny and/or confirmation include:
 1. Transite drainage pipe - whether buried or above grade - not permitted.
 2. Insulation and/or jacketting for pipes, ducts, motors, pumps, etc. - not permitted if any asbestos is present.
2. Solder for all piping is to be lead-free. "Lead Free" shall mean solder which contains less than 0.030% of lead when dissolved in fluoroboric and nitric acids and tested by inductively coupled argon plasma atomic emission spectroscopy. Steelbond 281 and Silverbrite are acceptable solder products.

The mechanical contractor shall provide an affidavit signed by the principal of the company, on company letterhead, that all of the solder used on the project was either one of the two acceptable products or that the solder used (identified by brand name) meets or exceeds the testing criteria.

The Owner shall undertake random testing of the soldered joints. Should testing provide that the solder used was not as specified, the Owner shall take legal action against the contractor as appropriate.

3. All paint and finish coatings are to be lead and mercury-free. Submit Material Safety Data Sheets confirming that these products are free of all lead and/or mercury compounds.

5. FIRE SAFETY REQUIREMENTS

1. Comply with requirements of the local municipal fire department with respect to continuous fire safety on the job site.
2. Comply with fire safety requirements of other construction related authorities (Workplace Safety & Insurance Board, Ministry of Labour, construction trade unions, etc.). If more than one authority issues similar

requirements, the more stringent shall govern.

3. The appropriate clauses of the Ontario Building Code relating to fire protection shall be strictly followed.
4. Provide and maintain free access to temporary or permanent fire hydrants and other fire protection equipment during performance of work required by insurance companies having jurisdiction and governing codes, regulations and by-laws.

6. OVERLOADING

1. Ensure no part of Work is subjected to a load which will endanger its safety or cause permanent deformation.

7. FALSEWORK

1. Design and construct falsework in accordance with latest issue of CSA S269.1-.

8. SCAFFOLDING

1. Design and construct scaffolding in accordance with latest issue of CSA-S269.2-.

9. LIST OF MINIMUM SAFETY

1. Include all provisions for construction safety such as fences, hoarding along streets, storage provisions facilities, sanitation facilities, fire protection, electrical supply, temporary heat, ventilation, construction equipment with its supports and guards, stairs, platforms, ladders, scaffolds, guardrails, walkway lighting and morality lighting, work around asbestos lead, silica and fumes, all as required by the Construction Safety Act and Regulation, latest edition of the Province of Ontario, as well as all other applicable regulations of Jurisdictional Authorities.

10. OWNER SAFETY REQUIREMENTS

1. The Contractor will take all necessary steps to protect personnel (workers, visitors, general public, etc.) and property from any harm during the course of the contract.
2. All work procedures will be in accordance with Client legislated standards.
3. All equipment shall be in safe operating condition and appropriate to the task.
4. The Contractor shall ensure that only competent personnel are permitted work on site. The owner will throughout the term of the contract also remove from the site any persons not observing or complying with safety

requirements.

5. The Contractor shall provide competent personnel to implement their safety programs and ensure that the owner's standards and those of the Ontario Health and Safety Act are being complied with.
6. Plant Services or the consultant will monitor every week to ensure that safety requirements are met and that safety records are properly kept and maintained. Continued disregard for safety standards can cause the contract to be cancelled and the Contractor or subcontractors removed from site.
7. The Contractor will report to the owner, architect and jurisdictional authorities any accident or incident involving Contractor, owner or public personnel and/or property arising from the contractor's execution of the work.

END OF SECTION

1. GENERAL

1. FIRES

1. Open fires and burning of rubbish are not permitted on the site.

2. DISPOSAL OF WASTES

1. Do not bury rubbish and waste materials on site.
2. Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.
3. All removal of waste products and debris resulting from the work must be audited and source-separated to comply with the most current version O.Reg 102 103 Industrial, Commercial and Institutional Source Separation Programs under the Environmental Protection Act and the 3 R's Regulation.

3. DRAINAGE

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

4. SITE CLEARING AND PLANT PROTECTION

1. Refer to Division 2.

5. POLLUTION CONTROL

1. Provide and maintain temporary erosion and pollution control features including mud mats and siltation fences per the local authority and Ontario provincial standard details and requirements installed under this contract or previously installed.
2. Control emissions from equipment and plant to local authorities emission requirements.
3. Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.
4. Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

6. NOISE CONTROL

1. Adhere to local noise bylaws.

2. Equip vehicles and equipment with efficient noise attenuation devices (mufflers) to minimize noise levels in vicinity of Site
3. Where necessary place noise attenuation devices (barriers) around stationery pumps and compressors.

7. WASTE MANAGEMENT CONTROL

1. Prepare Waste Audit and Waste Reduction Plans in accordance with O.Reg. 102/94 made under the environmental Protection Act for Waste Audits And Waste Reduction Work Plans. Ensure these plans are prepared prior to construction or demolition work proceeds on Site.
2. Prepare and implement a Source Separation Program in accordance with Ont. Reg. 103/94 made under the environmental Protection Act for Industrial Commercial source Separation Programs. Ensure program is implemented prior to construction or demolition work proceeds on Site.
3. Post plans on Site where most workers will see them, and allow any worker to view plans who makes such a request.
4. The following set of definitions are intended to augment terms provided within this Article:

1. 3 R: REDUCE (REDUCTION), REUSE, RECYCLE

1. REDUCE (REDUCTION) - Reduction involves actions to minimize quantity of waste at source and consequently, assumes highest priority in hierarchy of 3R activities.
2. REUSE - Direct reuse of products which otherwise would become waste, provides another means of diverting quantity of waste destined for landfill.
3. RECYCLE - Recycling involves collection of materials for use as feedstock in manufacturing of new products. Recycling can be most effectively accomplished if recyclable materials have been source separated at point of generation.
2. SOURCE SEPARATION - Purposeful segregation of materials from designated solid waste stream into specific material types at point of generation to facilitate recycling.
3. SOURCE SEPARATED MATERIALS - Specific types of materials that have been purposefully segregated from municipal waste into specific material types at point of generation.
4. CONSTRUCTION BUSINESS - Business enterprise employing more than 50 persons out of 1 office involved in building, renovation and repair of immobile structures, including soil excavation and landscaping.

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5. DEMOLITION BUSINESS - Business enterprise employing more than 50 persons out of 1 office involved in dismantling any immobile structure, facility or dwelling.
 5. Apply waste management activities of reduction, reuse and recycling of waste materials during construction and/or renovation of this Contract.
 6. Construction/Demolition Businesses shall be required to source separate in accordance with Ont. Reg. 103/94, for purposes of recycling, following materials
 1. corrugated cardboard
 2. wood waste (i.e. non-treated dimensional lumber, manufactured wood)
 3. non-painted gypsum board
 4. ferrous metals
 5. Brick and Portland cement concrete
 7. Submit agreement as requested to include source separation of above identified materials and other waste diversion activities during construction phase.
 8. Requirements: During construction phase, Contractor shall be required to comply with following program requirements:
 1. Identify sorting, storage and disposal requirements anticipated during construction to maximize waste diversion;
 2. Establish reduction, reuse and on-site source separation activities during construction;
 3. Identify haulers and recycling companies that have entered into agreement with or have expressed willingness to enter into such agreement with Contractor;
 4. Identify person responsible for source separation program;
 5. Establish effective education and information program for on-site employees, including training sessions, use of signs, and designated waste diversion program;
 6. Establish cooperative agreements with Sub-Contractors/trades to abide by waste diversion program.
 9. Contractor shall be willing to allow monthly on-site visits by Architect to review waste management/recycling program.
 10. Immediately upon notification of award of Contract, and before starting work on Site, submit fully completed "Sub-Contractor Participation Form" appended to this Section to the Architect.

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11. Contractors shall provide evidence that they can and shall implement required waste diversion program. Provision of evidence includes, but is not limited to following:
 1. Written agreements with Sub-Contractors that they will participate in waste diversion program;
 2. Letters from reuse/recycling markets that they are in position to accept designed materials;
 3. Action plan prepared by Contractor for meeting objectives of waste diversion program; and
 12. Contract Sum shall include costs for implementing waste diversion program.

END OF SECTION

1 Requirements Included

- .1 Reference standards.
- .2 Product quality, availability, storage, handling, protection, transportation.
- .3 Manufacturer's instructions.
- .4 Workmanship, co-ordination, cutting, fastenings.

2 Reference Standards

2.1 Within the text of the specifications, reference may be made to the following standards:

- ACI - American Concrete Institute
- AISC - American Institute of Steel Construction
- ANSI - American National Standards Institute
- ASTM - American Society of Testing and Materials
- CEC - Canadian Electrical Code (published by CSA)
- CEMA - Canadian Electrical Manufacturer's Association
- CGSB - Canadian General Standards Board
- CISC - Canadian Institute of Steel Construction
- CLA - Canadian Lumberman's Association
- CPCA - Canadian Painting Contractors' Association
- CPCI - Canadian Prestressed Concrete Institute
- CRCA - Canadian Roofing Construction Association
- CSA - Canadian Standards Association
- FM - Factory Mutual Engineering Corporation
- IEEE - Institute of Electrical and Electronic Engineers
- IPCEA - Insulated Power Cable Engineers Association
- NAAMM - National Association of Architectural Metal Manufacturers
- NBC - National Building Code
- NEMA - National Electrical Manufacturers' Association
- TTMAC - Terrazzo, Tile and Marble Association of Canada
- ULC - Underwriters' Laboratories of Canada

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

2.2 Conform to latest date of issue of reference standards and amendments effect on date of submission of bids except where a specific date or issue is specifically noted.

2.3 Where Drawings and/or specifications exceed code or standard requirements, provide such additional requirements.

2.4 Where codes or standards or this specification does not provide all information necessary for complete installation of an item, then strictly comply with the manufacturer's instructions for first quality workmanship. In cases of discrepancies consult the Architect for clarification.

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- 2.5 In the event of conflict between any provisions of relevant codes and standards, the requirement of authority having jurisdiction shall apply.
- 3 Products and Materials
- 3.1 Quality
- 3.1.1 Products, materials, equipment and articles (referred to as Products throughout the specifications) incorporated in the Work shall be new, not damaged or defective, and of the best quality (compatible with specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.
- 3.1.2 Defective Products, whenever identified prior to the completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.
- 3.1.3 Should any dispute arise as to the quality or fitness of Products, the decision rests strictly with the Consultant based upon the requirements of the Contract Documents.
- 3.1.4 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.
- 3.1.5 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.
- 3.2 Availability
- 3.2.1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of Products are foreseeable, notify the Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- 3.2.2 In the event of failure to notify the Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Consultant reserves the right to substitute more readily available products of similar character, at no increase in Contract Price.
- 3.2.3 Storage, Handling and Protection
- .1 Handle and store products in a 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 seals and labels intact. Do not remove from packaging or bundling until required in the Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, ie. lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged Products at own expense and to the satisfaction of the Consultant.

4 Manufacturer's Instructions

- 4.1 Unless otherwise indicated in the 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.
- 4.2 Notify the Consultant, in writing, of conflicts between the specifications and manufacturer's instructions, so that the Consultant may establish the course of action.
- 4.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes the Consultant to require removal and re-installation at no increase in Contract Price.

5 Workmanship

5.1 General

- 5.1.1 Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required Work is such as to make it impractical to produce required results.
- 5.1.2 Do not employ any unfit person or anyone unskilled in their required duties.

Where required by code or other by-laws and regulations, trades people shall be licensed in their trade. The Consultant reserves the right to require the dismissal from the site, workers deemed incompetent, careless, insubordinate or otherwise objectionable.

5.1.3 Any work not acceptable to the County, the Consultant or local authorities shall be removed and replaced when and as directed by them. The cost of re-executing such work shall be borne by the Contractor.

5.1.4 Where not otherwise specified or shown, all work must conform to the local governing codes and by-laws and to the Ontario and National Building Codes. All codes, standards, regulations and by-laws shall be of the latest date or amendment prior to tender issue.

5.2 Co-ordination

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

5.2.2 Be responsible for co-ordination and placement of openings, sleeves and accessories.

5.3 Concealment

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

5.3.2 Before installation, if any doubt arises as to means of concealment, or the intention of the Contract Documents in this regard, inform the Consultant before proceeding with the portion of work in question.

5.3.3 Make arrangements to have mechanical and electrical work and all structural components laid out well in advance of concrete placement and furring installation so that provision may be made for proper concealment. All such work shall be tested, inspected, pipe and duct covering applied where applicable, and approved before being concealed.

5.3.4 The Contractor takes full responsibility for informing the Consultant in advance of concealment, and shall notify the Consultant and arrange with the Consultant a time when a site review can take place prior to concealment. Failure to do so and any consequent opening up of finishes and structure is the sole responsibility of the Contractor.

5.4 Cutting and Remedial Work

5.4.1 Perform cutting and remedial work required to make the parts of the Work come together. Co-ordinate the Work to ensure this requirement is maintained.

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- 5.4.2 Should work performed outside this contract necessitate cutting and/or remedial work to be performed, the cost of such work will be valued by the Consultant.
- 5.4.3 Perform cutting and remedial work by specialists familiar with the materials affected. Perform in a manner to neither damage nor endanger any portion of Work.
- 5.5 Location of Equipment & Fixtures
- 5.5.1 Obtain manufacturer's literature for roughing-in and hook-up of equipment, fixtures and appliances.
- 5.5.2 Submit field drawings to indicate relative position of various services and equipment when required by Consultant.
- 5.6 Fastenings
- 5.6.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- 5.6.2 Prevent electrolytic action between dissimilar metals and materials.
- 5.6.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification Section.
- 5.6.4 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- 5.6.5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- 5.6.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.
- 5.7 Protection of Work in Progress
- 5.7.1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Consultant, at no increase in Contract Price.
- 5.7.2 Adequately protect troweled concrete floors and finished flooring from damage. Take special measures when moving heavy loads or equipment on them.
- 5.7.3 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Consultant.

END OF SECTION

1. GENERAL

1. REQUIREMENTS INCLUDED

1. Systems demonstration
2. Document submission
3. Project commissioning
4. Inspection and takeover procedures

2. SYSTEM DEMONSTRATION

1. Prior to substantial performance, demonstrate operation of each system to the Owner and Consultant.

3. DOCUMENTS

1. Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers, and manufacturers. Submit as per requirements in Section 010100 - General Requirements.
2. Provide bonds fully executed and notarized.
3. Submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and monies remaining due.
4. Architect will issue a final change order reflecting approved adjustments to Contract Sum not previously made.

4. PROJECT COMMISSIONING

1. Expedite and complete deficiencies and defects identified by the Consultant.
2. Review record "as-built" drawings for completeness and then provide "as-built" AutoCad 2016 or later drawings.
3. Review Cash and Contingency Allowances in relation to Contract Price, change orders, hold-backs and other Contract Price adjustments.
4. Submit required documentation such as statutory declarations, Workplace Safety & Insurance Board Certificates, certificates of approval or acceptance from regulating bodies.
5. Attend "end-of-work" testing and break-in or start-up demonstrations.
6. Review inspection and testing reports to verify conformance to the intent

of the documents and that changes, repairs or replacements have been completed.

7. Meet with inspection and testing company to co-ordinate completion, testing approvals.

5. INSPECTION/TAKEOVER PROCEDURES

1. The requirements of OAA/OGCA Document No. 100 "Take-Over Procedures" also govern applicable take-over procedures for this Contract.
2. Prior to application for certificate of Substantial Performance, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete and/or corrected and the building is clean and in condition for occupancy. Notify the Architect, in writing, of satisfactory completion of the Work and request an inspection.
3. During the Architect/Consultant inspections, lists of deficiencies and defects will be tabulated. Correct same.
4. When the Architect/Consultants consider deficiencies and defects have been corrected and it appears requirements of the Contract have been performed, make application for certificate of Substantial Performance. Refer to General Conditions Article GC 14 for specifics to application.
5. All utility meters to be read and transferred into the Owner's name.

END OF SECTION

1. GENERAL

1. DUST AND CLEANING REQUIREMENTS

1. Standards: Maintain project in accordance with the latest edition of The Occupational Health and Safety Act.
2. Hazards and Dust Control
 - .1 Provide adequate ventilation during use of volatile or noxious substances.
 - .2 Prevent spread of dust beyond the construction site by wetting, or by other means suitable for conditions, as it accumulates.
 - .3 Provide Tack Mats at entrances to prevent dust and dirt from being traced through the project as required. Dispose of mats and replace on regular basis with new mat.
3. Floors
 - .1 Keep troweled concrete floors free from oils, grease or other materials likely to damage them, discolour them or affect bond of applied finishes. Once building is enclosed, keep floors as dry as possible after curing.
 - .2 To prevent soiling or damage to finish flooring where pedestrian traffic occurs after the flooring has been installed, install and maintain reinforced kraft paper temporary protection, secured in place and with joints sealed by reinforced pressure sensitive tape.
 - .3 Install plywood panels of minimum 1/4" thickness over completed finish flooring materials on which further construction work is performed or delivery of products is made, or both. Seal joints between panels with reinforced pressure sensitive tape.

2. PRODUCTS

1. MATERIALS

1. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

2. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

3. EXECUTION

1. DURING CONSTRUCTION

1. Execute cleaning to ensure that building, grounds, and public properties are maintained free from accumulations of waste materials and rubbish. Keep site clear of snow, mud and pooling of water due to severe rain. Ensure that work is not stopped because of failure to provide access to site.
2. Wet down dry materials and rubbish to prevent blowing dust.
3. At reasonable intervals during progress of Work, clean site and public properties and dispose of waste materials, debris and rubbish.
4. Unless otherwise specified, salvaged material resulting from construction, and surplus materials and construction debris shall become property of Contractor, who shall dispose of it away from site.
5. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for Substantial Performance or occupancy.
6. Obtain from each Subcontractor, instructions which designate proper methods and materials to be used in final cleaning, and submit such instructions to the Consultant. Include Instructions in Manufacturer's Data Book specified in Section 01300.
7. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.
8. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.

2. FINAL CLEANING

1. At completion of Work, remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all surfaces exposed to view; leave project clean and ready for occupancy.
2. Employ experienced workers, or professional cleaners, for final cleaning.
3. In preparation for Substantial Performance or occupancy, conduct final inspection of interior and exterior surfaces exposed to view, and of concealed spaces.
4. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from all sight-exposed interior and exterior finished surfaces; polish resilient and ceramic surfaces so designated to shine finish. Vacuum carpet.
5. Clean and polish glass and mirrors.
6. Repair, patch and touch up marred surfaces to specified finish, to match adjacent surfaces.
7. Broom-clean paved surfaces; rake clean other surfaces of grounds.
8. Clean filters, exposed ductwork, and structure.
9. Clean bulbs and lamps and replace those burned out.
10. Clean diffusers and grilles.
11. Clean sinks, faucets, and water closets and controls.
12. All exposed interior surfaces to be cleaned.
12. Remove snow and ice from access to building.
13. Maintain cleaning until project, or portion thereof, is occupied by Owner.

3. REMOVAL OF TEMPORARY FACILITIES

1. Completely remove temporary facilities from site, making good any damage when no longer required.

END OF SECTION

The printed forms outlined below shall form the basis of communication between the Architect and the General Contractor. Copies of forms unrelated to the issuance of monies, shall be kept on the site; neatly filed and readily accessible to the parties concerned.

1. TRANSMITTAL RECORD

A record of material issued by the Architect or General Contractor.

2. GENERAL REVIEW REPORT

A progress report completed by the Architect or Consultant on a regular basis (minimum monthly).

3. PROPOSED CHANGE

A description of contemplated changes to the Contract.

4. CASH ALLOWANCE EXPENDITURE

Assignment of money for work executed under the Cash Allowance Section.

5. CHANGE ORDER

Assignment of money for work executed beyond the financial limits of the Contract.

6. CHANGE DIRECTIVE

A description of a change in the work when the Owner requires the Contractor to proceed with a change in the work prior to the Owner and the Contractor agreeing upon the adjustment in Contract Price and Contract Time.

7. CERTIFICATE FOR PAYMENT

For release of contract money based on monthly progress draws.

8. SUPPLEMENTAL INSTRUCTIONS

A description and/or clarification for the purpose of recording a clarification or interpretation of the contract documents or giving directions on problems resulting from field conditions.

END OF SECTION

1. NEWFORMA SOFTWARE SYSTEM

- 1.1 This project will be administered through the Architect using the NEWFORMA software system.
- 1.2 The Contractor is required to use this internet based software for ALL RFIs, quotations, shop drawings. All documents shall be submitted electronically through the Newforma Info Exchange in PDF format and shall be numbered in the order which they are submitted. Numbering shall be in the following format; 001, 002, 003, etc. Submittals will not be deemed as received unless delivered through Newforma Info Exchange.
- 1.3 Utilization of this system does not require the purchase or download of the Newforma software. The Architect will send an email notification which will automatically provide online access to the Newforma Info Exchange specific to this project.

2. NEWFORMA INSTRUCTIONS

1. You will receive an email instructing you how to get into the system (click on link). The system is self-explanatory as to the "use" for Submittals (Shop Drawings) and RFIs. Refer to attached screen shots.
2. Shop Drawings are to be issued as "Submittals". There is a place on the Submittal section to put in the Contractor's "expected response date" – please ensure that is filled in. Submittals are to be numbered in the sequence which they are submitted. Numbering to be as follows; 001, 002, 003, etc. (NOTE: as per the contract, the Architect has 10 working days to respond).
3. RFIs: There is a place on the RFI section to put in the Contractor's "expected response date" – please ensure that is filled in. RFI's are to be numbered in the sequence which they are submitted. Numbering to be as follows; 001, 002, 003, etc.. (NOTE: as per the contract, the Architect has 5 working days to respond)
4. RFCs: (all Contractor quotations to be submitted as an RFC) RFC's are to be numbered in the sequence which they are submitted. Numbering to be as follows; 001, 002, 003, etc.
5. Submittals and RFI's requiring consultant review other than the Architect shall be sent via Newforma directly to the respective consultant. The +VG Project Manager as well as the persons noted above shall be copied on all submittals and RFI's.
6. All shop drawings, interference drawings and as-built drawings shall be submitted electronically through the Newforma Info Exchange in PDF format. Submittals will not be deemed as received unless delivered through Newforma Info Exchange.

END OF SECTION

1. GENERAL

1.1 GENERAL REQUIREMENTS

1. Conform to Division 1 - General Requirements.

1.2 EXAMINATION OF SITE AND EXISTING BUILDING(S)

1. Carefully examine the site to ensure that all factors concerning demolition of site elements at areas 1500mm beyond existing building perimeters are known, particularly those concerning:
 1. Existing equipment and/or materials which are to be turned over to the Client.
 2. Nature and extent of existing materials to be demolished or removed.
 3. **Existing exit facilities of adjacent building(s) requiring hoarding protection during demolition and construction.**
2. The drawings indicate the existing buildings which are to be demolished and removed from the site. All building components including fencing, footings, foundations, fill, asphalt paving, curbs, sidewalks, granular material below, and underground services are to be removed as part of the base contract.
3. **The existing adjacent Theatre and Civic Centre which abut the building to be demolished are to remain operational during demolition and construction. Provide all Work required for protection of these buildings as well as any hoarding protection required to maintain exiting of these buildings all to the requirements of the Local Authority having jurisdiction and all applicable Municipal and Provincial Regulations.**

1.3 REQUIREMENTS OF REGULATORY AGENCIES

1. Ontario Building Code, as currently amended.
2. The Construction Safety Act, (as currently amended), local by-laws and all other regulations of the Ontario Ministry of Labour relating to the work of this section.

1.4 CO-ORDINATION AND CO-OPERATION

1. Co-ordinate the work of the Section with the work of all other sections affected to ensure proper sequencing and the safety and stability of the affected structures at all times.
2. Construction phasing and sequencing in coordination with the Town of

Hanover for operations of the existing Theatre, Civic Centre and Church properties for; hours of operation, disruption of services, protection of exiting of those facilities.

1.5 PERMITS

1. Obtain and pay for all necessary Municipal and other permits required to carry out the work of this section.

1.6 INSURANCE

1. This Contractor shall carry General Liability Insurance as well to protect the Architect, its' Consultants and the Owner from all claims of public liability and property damage. This insurance is in addition to the required liability insurance and other insurances described in the General Conditions of CCDC Document 2 -2020.

1.7 WORK INCLUDED IN THIS SECTION

1. This work of this section shall consist of furnishing labour, material, tools, equipment and special services necessary to complete any required abatement and demolition work for complete removal of the existing Fire Station, including but not limited to: existing buildings, fencing, foundations, footings, asphalt paving, curbs, sidewalks and granular below, above and below grade sanitary and storm services including gas and water lines, as required.

1.9 SUBMITTALS

1. Where required by authorities having jurisdiction, submit Engineered drawings, diagrams of details showing sequence of dismantling work and shoring of structures during demolition.
2. Drawings for structural elements shall bear signed professional seal of Structural Engineer licensed to practice in Ontario.
3. Submit the following for removal of any unknown underground tanks in accordance with Section 01300 Submittals:
 1. All test reports required by Federal, Provincial and Municipal authorities and regulatory agencies.
 2. Inspection permits.
 3. Copies of underground tank closure notifications.
 4. Any permits, plans, disposal paperwork and certificates required for underground tank removal.

1.10 PRE-DEMOLITION MEETING

1. Prior to start of work, arrange for Site meeting of all parties associated with the work of this Section. The meeting shall include the Architect, Owner, Demolition Contractor, Abatement Contractor, Hazardous Materials Subcontractor(s), Testing Company Representative, Site Servicing Engineer and Structural Engineer.
2. Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, methods to be used, sequence and quality control, project staffing, restrictions due to environmental protection requirements, operations of adjacent buildings, and other matters affecting demolition, to permit compliance with intent of this Section.

2. PRODUCTS

2.1 MATERIALS

1. All demolished materials will become the Contractor's property and the Contractor must remove them from the site except for any specific items to be retained for re-use or turned over to the Owner. In general this consists of technology shop and food services equipment to be relocated to the new school. Coordinate with owner for location of items to be turned over, exterior placement are to be on wood skids and covered weather tight from the elements. A list of these items if any will be provided during the bid period and are also noted as salvaged materials / items in the demolition drawings.
2. Remove contaminated and dangerous material from Site and dispose of in a safe manner according to regulations of authorities having jurisdiction to minimize danger involved at Site or anytime during disposal.

Conform to requirements of Section 01 56 00 Environmental Protection Requirements.

3. EXECUTION

3.1 PROTECTION

1. Protect adjacent property against damages which might occur from falling debris or other causes. Do not interfere with use of adjacent buildings and maintain free, safe passage to and from same. **Note: Theatre emergency exits open directly onto the demolition/construction site and shall be maintained throughout to the completion of the construction project. Civic Centre east emergency exit is directly**

adjacent to the area of Work and shall be protected and maintained throughout the construction project.

2. Take precautions to guard against movement or settlement of adjacent buildings; provide and place bracing or shoring; be responsible for safety and support of such buildings; be liable for any such movement or settlement, any damage or injury caused thereby or resulting therefrom. If at any time, safety of any adjacent structure or buildings appear to be endangered, cease operations, notify the Architect; take precautions to support such buildings; do not resume operations until permission has been granted. If such movement or settlement of adjacent buildings is caused by negligence or default of this Contractor, they shall install sufficient bracing or shoring with no extra cost to the Owner. If Architect considers additional bracing or shoring necessary to safeguard, prevent such movement or settlement, install bracing or shoring upon Architect's order; if Contractor fails to comply promptly with such order, such bracing, shoring may be placed by Architect, at Contractor's expense.
3. In general, existing masonry walls above grade require structural lateral supports at vertical or horizontal intervals not exceeding 20 times the thickness of the masonry.
4. This Trade Contractor is responsible for the design and installation of all necessary bracing or shoring for the superstructure for all phases of the demolition.

3.2 WORKMANSHIP

1. Demolition shall be carried out in strict accordance with provincial, local and municipal authorities and the Ontario Building Code.
2. During demolition operations, keep work dampened down to prevent dust and dirt rising.
3. All mechanical and electrical devices shall be disconnected and removed by the licensed electricians and plumbers.
4. If during demolition work hazardous material other than specified to be removed is discovered then stop work in the affected area and immediately notify Architect.
5. Dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.
6. At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling or unprotected excavations are exposed.
7. Demolish to minimize dusting. Keep dusty materials wetted.

**DEMOLITION,
SUPERSTRUCTURE, SHORING
AND BRACING**

8. Demolish masonry and concrete walls in small sections. Carefully remove and lower structural framing and other heavy or large objects.
9. Do not sell or burn materials on site.
10. Materials and debris shall not be stacked in building to extent that overloading of any part of structure will occur.
11. Remove contaminated or dangerous and hazardous materials from site and dispose of in safe manner to minimize danger at site or during disposal. Comply with all regulations and by-laws of Municipal and Provincial Authorities having jurisdiction. Separate and recycle all building materials that are recyclable, see Section 01560 Environmental Protection Requirements. Provide separate bins for each recyclable material.
12. Drawings and notes are intended to convey the general intent of demolition and removal required for the work of this Contract but are not intended to highlight or point out every element requiring demolition or removal. Contractor is to review drawings and specifications which indicate the required finished project and perform the demolition required to allow the indicated changes and/or construction to take place.
13. Contractor is to plan and bid the Work of this Section as a demolition project. As such, the Contractor must allow for removal and demolition of items which are not fully visible during the bidding phase. It is not possible to indicate all specific items requiring demolition on the drawings.
14. Contractor to allow for cutting, patching, holes, sealing of existing openings which may be required to accomplish the work indicated.
15. Hand and mechanical demolition shall be acceptable methods for work of this Section. Verify with Architect whether proposed methods of demolition are acceptable. The use of rapid progress failure methods of demolition (explosives) will not be permitted.
16. Inform Architect immediately if conditions are encountered during demolition which are significantly beyond those which could have reasonably been anticipated or inferred based upon the Contract Documents and examination of the building prior to commencement of work.

3.3 EXISTING SERVICES

1. Provide and maintain temporary services required during demolition to satisfaction of authorities having jurisdiction, fire departments and utility companies.

**DEMOLITION,
SUPERSTRUCTURE, SHORING
AND BRACING**

2. Before commencing demolition, contact Electrical Department of local authority and tour Site with them. Disconnect and seal electrical power lines and communications cables entering buildings to be demolished. Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.
3. Disconnect and cap mechanical services in accordance with requirements of local authority having jurisdiction. Natural gas supply lines shall be removed by Gas Company or by qualified tradesman in accordance with Gas Company instructions. Remove and dispose of other existing underground services and mechanical equipment.
4. In event of unexpected discovery of additional buried fuel or other tanks, do no further work and immediately report discovery, orally and in writing to Architect. Architect will authorize remedial work, if any, in writing. Do such remedial work, as addition to Contract.
5. Remove electrical equipment as required by the work.
6. Remove sewer and water lines to extent as required by the work and cap to prevent leakage.

END OF SECTION

PART ONE - GENERAL

1.1 DESCRIPTION

- 1.1.1 Work included: Furnish all labour, materials, equipment and services specified, indicated, or required to provide excavating, trenching, backfill and compaction.
- 1.1.2 Related Work Described Elsewhere:
 - .1 Soils Report – Section 02010.
 - .2 Earthwork Below Paving and Sidewalks - Section 02215.
 - .3 Site Servicing and Grading
 - .4 Division 22 – Plumbing
 - .5 Division 26 - Electrical

1.2 SAMPLES

- 1.2.1 Submit 20 kg (45 lbs.) samples of each type of fill specified including representative samples of excavated materials for analysis by testing laboratory.
- 1.2.2 Ship samples prepaid to testing laboratory in tightly closed containers to prevent contamination.

1.3 SUBMITTALS

- 1.3.1 Comply with pertinent provisions of Section 01300 regarding shoring, bracing and underpinning required in connection with excavation.
- 1.3.2 If drawings for structural elements are required, they shall bear the signature and stamp of a Professional Engineer Registered in Ontario.

1.4 SHORING AND BRACING

- 1.4.1 Take precautions to guard against movement or settlement of adjacent structures, earth, benchmarks, services, walks, paving, curbs and adjacent grades. Provide bracing and shoring if required.
- 1.4.2 Shore and brace excavations to prevent failure in accordance with *Construction Safety Act* and *Shoring and Timbering in Trenches* by the Construction Safety Association of Ontario.
- 1.4.3 Engage a registered structural engineer to design and assume responsibility for shoring, bracing, and caissons.
- 1.4.4 Make good any damage and be liable for any injury resulting from inadequate shoring or bracing.

1.5 DEWATERING

- 1.5.1 Take precautions necessary to sufficiently dewater excavation and fill areas to allow foundation construction and pipe installation.

1.6 UTILITY LINES

- 1.6.1 Where possible, known underground and surface utility lines are indicated. Locations of known existing services on plans are only approximate. Contractor shall be responsible for locating their exact position during the work. Notify Public Utility or Municipal Authorities well in advance of planned excavations and shoring adjacent to their services.
- 1.6.2 Record locations of maintained, re-routed and abandoned underground utility and sewer lines.
- 1.6.3 Make good any damage caused to existing utility and sewer lines resulting from work.

1.7 PROTECTION

- 1.7.1 Protect excavated earth from freezing by approved method.
- 1.7.2 Grade around excavations to prevent surface water runoff into excavated area.

PART TWO - PRODUCTS

2.1 MATERIALS

- 2.1.1 Reference to the abbreviation MTC indicates Ontario Ministry of Transport and Communications.
- 2.1.2 Grade Fill: Type 1 fill - Granular 'A' material conforming to OPSS Form #1010. Crushed rock composed of hard, uncoated cubical fragments produced from a naturally formed deposit and graded within the following limits:

Sieve Size (MTC)	Percent Passing
37.5 mm	100
16.0 mm	62-100
9.5 mm	48-73
4.75 mm	33-55
1.18 mm	15-45
300 µm	5-22
75 µm	0-8

- 2.1.3 Subgrade Fill: Type 2 fill - Granular 'B' material conforming to OPSS Form # 1010. Clean sand and gravel graded within the following limits:

Sieve Size (MTC)	Percent Passing
106.0 mm	100
22.4 mm	57-100
4.75 mm	26-100
10-85	1.18 mm
5-40	300 um
0-8	75 um

- 2.1.4 All fills shall be free of frost, ice or frozen particles, or stones greater than 106mm for granular 'B' or 37.5mm for granular 'A'.

2.2 STOCKPILING

- 2.2.1 Stockpile fill materials in areas designated by Consultant. Stockpile granular materials in a manner to prevent segregation. Protect from freezing.

PART THREE - EXECUTION

3.1. EXCAVATING

- 3.1.1 Excavate to elevations and dimensions indicated or required for construction of work plus space required to erect forms, shoring, permit inspection.
- 3.1.2 Make excavation to clean lines to minimize quantity of fill material required.
- 3.1.3 Earth bottoms of excavations to be dry undisturbed or previously compacted soil, level, free from loose or organic matter.
- 3.1.4 Excavation must not interfere with normal 45° splay of bearing from bottom of any footing.
- 3.1.5 When complete, have Consultant inspect excavations before pouring any concrete.
- 3.1.6 Correct unauthorized excavation at no extra cost as follows:
.1 Fill under bearing surfaces and footings with concrete as specified for footings.
.2 Fill under other areas with Type 2 fill compacted to 100% Standard Proctor Density.

3.2 EXCESS WATER CONTROL

- 3.2.1 Unfavourable weather: Do not place, spread, or roll and fill material during unfavourable weather conditions. Do not resume operations until moisture content and fill density are satisfactory to the Consultant.
- 3.2.2 Softened subgrade: Where soil has been softened or eroded by flooding or placement during unfavourable weather, remove all damaged areas and recompact as specified for fill and compaction below.

3.2.3 Dewatering:

- .1 Provide and maintain at all times during construction, ample means and devices with which to remove promptly and dispose of all water from every source entering the excavations or other parts of the work.
- .2 Dewater by means which will ensure dry excavations and the preservation of the final lines and grades of bottoms of excavations.

3.3 BACKFILLING

- 3.3.1 Do not commence backfilling until work of other sections to be backfilled has been inspected by the Consultant.
- 3.3.2 Areas to be backfilled to be free from debris, snow, ice, water or frozen ground.
- 3.3.3 Prior to placing fill under base courses and slabs on grade, compact existing sub-grade to obtain same compaction as specified for fill. Cut out "soft" areas and fill with suitable material until specified compaction can be obtained.
- 3.3.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by the Consultant.
- 3.3.5 Backfill simultaneously each side of walls and other structures to equalize soil pressures, when possible.
- 3.3.6 Place and compact fill materials in continuous horizontal layers not exceeding 150mm (6") loose depth. Avoid disturbing or damaging buried services. Make good any damage. Increased fill depths are not to be attempted without demonstration of compaction to Consultant.
- 3.3.7 Maintain optimum moisture content to enable compaction to attain specified density.
- 3.3.8 Where sheathing and shoring materials are used to support sides of excavation and are to be later removed, leave them in place as long as possible, compatible with the placing and compacting of backfill, in order to eliminate voids or pockets in the backfill and to minimize possible movement or loss of adjacent ground and damage to facilities.
- 3.3.9 Bring all filled areas to rough grade level. Leave surfaces clean and free of coarse materials.
- 3.3.10 Bedding of Mechanical and Electrical Services to be carried out by this Section under the direction of the trade concerned using cohesionless material.

3.4 FILL TYPES AND COMPACTION

- 3.4.1 Exterior sides of perimeter walls: use granular "B" to sub-grade levels. Compact to 95% Standard Proctor maximum dry density.

- 3.4.2 Within building area: Use granular "B" to underside of base course for concrete slabs. Compact to 100% Standard Proctor maximum dry density.
- 3.4.3 Under concrete slabs, including areas under thickened slabs: provide 150mm (6") base course of granular "A" fill to underside of slab. Compact to 100% Standard Proctor maximum dry density.

3.5 GRADING

- 3.5.1 Rough grading to levels, profile and contours required and made ready to receive surface treatment as indicated on site plan.

3.6 INSPECTION AND TESTING

- 3.6.1 Testing of materials and compaction will be carried out by testing laboratory designated by the Consultant.
- 3.6.2 Owner will pay for inspection and testing costs.
- 3.6.3 Sieve analysis: proposed fill materials will be tested to confirm suitability for intended use and conformity with specifications.
- 3.6.4 Density tests: tests will be conducted in place on compacted fill to ASTM D2922 for Standard Proctor Density.
- 3.6.5 If, during progress of work, tests indicate fills installed under this contract do not meet specified requirements, remove defective fills, replace and retest at Contractor's expense. All re-testing is to be at the Contractor's expense.

3.7 FREQUENCY OF TESTS

- 3.7.1 Consultant will determine frequency of testing as construction progresses. The following materials will be tested: excavated surfaces, fill under floor or other slabs on grade, backfill of structural walls.

3.8 SURPLUS

- 3.8.1 Remove surplus material not required for backfill, grading or landscaping, from the site.

3.9 INSULATION

- 3.9.1 Installation of perimeter foundation insulation specified under Section 07200 (Building Insulation) is to be installed by this Section as backfilling progresses.

END OF SECTION

PART ONE – GENERAL

1.1 SECTION INCLUDES

- 1.1.1 Provision of all labour, materials, equipment, and incidental services necessary to provide concrete formwork and accessories as indicated on the drawings and specified herein.

1.2 RELATED SECTIONS:

- .1 Section 03200 – Concrete Reinforcement
- .2 Section 03300 – Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

(All Codes and Standards referred to herein are to be latest edition.)

- .1 CAN/CSA-S269.3, Formwork.
- .2 CAN/CSA-A23.1, Concrete Materials & Methods of Concrete Construction.
- .3 CAN/CSA-A23.2, Methods of Test and Standard Practices for Concrete.
- .4 CSA-086, Engineering Design in Wood.
- .5 CSA 0121, Douglas Fir Plywood.

1.4 TOLERANCES

- 1.4.1 Perform forming operations and place hardware so that finished concrete will be within the tolerances set out in CAN/CSA-A23.1.
- 1.4.2 Variations in building lines which result in extension of the building over lot lines or restriction lines will not be permitted.
- 1.4.3 Tolerances referenced are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

1.5 DESIGN REQUIREMENTS

- 1.5.1 Design formwork to safely support vertical and lateral loads until they can be supported by the structure, as recommended in CAN/CSA-S269.3.

1.6 SHOP DRAWINGS

- 1.6.1 If requested by the Consultant submit shop drawings in accordance with Section 01300. Each shop drawing shall bear the stamp and signature of a Professional Engineer registered in the Province of Ontario.
- 1.6.2 Indicate method and schedule of construction, materials, arrangement of joints, ties, shores, and locations of temporary embedded parts. Comply with CAN/CSA-S269.3 for formwork drawings.

PART TWO – PRODUCTS

2.1 MATERIALS

- 2.1.1 Formwork Lumber. Wood for form facing for exposed concrete shall be exterior PMBC concrete form grade Douglas Fir Plywood or aluminum.
- 2.1.2 For non-architectural concrete work: plywood and wood formwork materials to CSA-086.1.
- 2.1.3 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface.
- 2.1.4 Tubular Column Forms: round, spirally wound laminated fiber forms, internally treated with release material.
- 2.1.5 Form Release Agent: chemically active release agents containing compounds that react with free lime in concrete, resulting in water insoluble soaps.

PART THREE – EXECUTION

3.1 FABRICATION AND ERECTION

- 3.1.1 Verify lines, levels and centers before proceeding with formwork and ensure dimensions agree with drawings.
- 3.1.2 Obtain Consultant's approval in writing for use of earth forms.
- 3.1.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- 3.1.4 Form footing sides unless footings are strictly specified to be placed against undisturbed soil.
- 3.1.5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- 3.1.6 Do not place shores and mud sills on frozen ground.
- 3.1.7 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 CAN/CSA-A23.1.
- 3.1.8 Where shown, camber formwork such that hardened concrete, prior to stripping of forms, is cambered as shown. Maintain beam depth and slab thickness from

cambered surface.

- 3.1.9 Align form joints and make watertight. Keep form joints to a minimum.
- 3.1.10 Use 25mm chamfer strips on external corners and/or 25mm fillets at internal corners of concrete members, unless specified otherwise.
- 3.1.11 Camber slabs and beams 1 in 500 of span unless shown otherwise.
- 3.1.12 Mark building, grid or other lines on forms to permit the accurate positioning of reinforcing steel.
- 3.1.13 Construct templates and supports to rigidly fix reinforcing dowels in the forms prior to concreting.
- 3.1.14 Provide suitable markers to indicate the location and configuration of continuing concrete members so that dowels can be positioned accurately in relation to their position in the continuing members.
- 3.1.15 Set anchor bolts, templates, steel connection units, hardware, or other inserts into the forms and secure them rigidly so that they do not become displaced during concreting. Set and secure these items to the tolerances specified and required in the appropriate Sections.

3.2 SLEEVES, CHASES AND FORMED OPENINGS

- 3.2.1 Form sleeves, chases and openings except where such items are specified to be formed or sleeved by the appropriate trade.
- 3.2.2 All openings, sleeves, chases are not necessarily shown on the structural drawings nor are their sizes or locations shown. Refer to architectural, mechanical and electrical drawings and specifications for openings and sleeving requirements not shown, located and dimensioned on the structural drawings.
- 3.2.3 No sleeves, chases and openings through structural members shall be formed without the Consultant's written approval.

3.3 REMOVAL AND RE-SHORING

- 3.3.1 Leave formwork in place for following min. periods of time after placing concrete:
 - .1 3 days for walls
 - .2 1 day for footings and abutments
 - .3 3 days for beams, slabs, decks and other structural members
 - .4 3 days for columns
- 3.3.2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and immediately replace

with adequate re-shoring.

- 3.3.3 Provide all necessary re-shoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

3.4 DEFECTIVE MATERIALS AND WORK

3.4.1 Materials or work which fail to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

PART ONE – GENERAL

1.1 SECTION INCLUDES

- 1.1.1 Provision of all labour, materials, equipment and incidental services necessary to provide all concrete reinforcement and accessories such as chairs, supports, bolsters etc.

1.2 RELATED SECTIONS

- 1.2.1 Section 03100 – Concrete Formwork
- 1.2.2 Section 03300 – Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

(All Codes and Standards referred to herein are to be latest edition)

- .1 Reinforcing Steel Institute of Ontario (RSIO), Manual of Standard Practice.
- .2 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- .3 CAN/CSA-A23.2, Methods of Test and Standard Practices for Concrete.
- .4 CSA-A23.3, Design of Concrete Structures.
- .5 CSA-G30.3, Cold Drawn Steel Wire for Concrete Reinforcement.
- .6 CSA-G30.5, Welded Steel Wire Fabric for Concrete Reinforcement.
- .7 CSA-G30.14, Deformed Steel Wire for Concrete Reinforcement.
- .8 CSA-G30.15M, Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- .9 CAN/CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement.
- .10 ANSI/ACI 315, Details and Detailing of Concrete Reinforcement.
- .11 ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
- .12 Ontario Provincial Standard Specification (OPSS) 1443 Material Specifications for Organic Coatings for Steel Reinforcement.

1.4 TOLERANCES

- 1.4.1 Perform fabrication and setting so that completed work will be within the tolerances set out in CAN/CSA-A23.1.
- 1.4.2 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

1.5 SUBMITTALS

- 1.5.1 Mill Certificates
 - .1 Reinforcement from Canadian Mills need not be tested. Steel from foreign mills shall be tested at no cost to the Owner.
- 1.5.2 Shop Drawings
 - .1 Prepare placing drawings to a minimum scale of 1:50 in a clear complete manner that will permit placing of reinforcement to be performed without

- reference to contract drawings.
- .2 Detail reinforcement in accordance with the contract documents, CAN/CSA-A23.1 and detailing standards in RSIO Manual of Standard Practice As a minimum, show the following:
- .1 Bar sizes, spacing, location and quantities of reinforcement, welded wire fabric.
 - .2 Identification of each bar with code mark corresponding to bar lists.
 - .3 Details illustrating placement of reinforcement at openings, change of levels, spandrels, stairs, etc.
 - .4 Clearances between reinforcement, and minimum concrete protection to reinforcement.
 - .5 Location and embedment of dowels.
 - .6 Location, number and type of support accessories.
- 1.5.3 Certificates
- .1 Canadian Manufacture: Provide Consultant with certified copy of reports of reinforcing steel showing physical and chemical analysis minimum (5) weeks prior to commencing reinforcing work.
 - .2 Submit code marks or symbols used on reinforcement of each manufacturer so that Consultant may identify grades and size of reinforcement.
- 1.5.4 Substitutions
- .1 Substitution of different size bars permitted only upon written approval of Consultant.

PART TWO – PRODUCTS

2.1 MATERIALS

- 2.1.1 Reinforcing Steel: Only Canadian manufactured deformed steel to CSA G30 Series and to the material specification shown on the drawings. Reinforcement larger than 6mm (1/4") diameter shall be deformed bars. Hard grade billet steel or rail steel shall not be used for stirrups, column or beam ties or spirals.
- 2.1.2 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1. In the case of concrete exposed to view or weather the accessories shall be such that no metal is permitted to come closer than 40mm from a formed face and 50mm from a troweled surface. Use precast concrete supports for exposed concrete beams and soffits and concrete cast against soil/rock.

2.2. FABRICATION

- 2.2.1 Fabricate reinforcing in accordance with CAN/CSA-A23.1 and the RSIO Manual of Standard Practice.
- 2.2.2 Identify with a tag each bar with code mark corresponding to that appearing on bar list.
- 2.2.3 Bend reinforcement once only and at room temperature. Do not straighten or re-bend reinforcement. Do not use bars with kinks or bends not shown on the

drawings.

- 2.2.4 Replace bars which develop cracks or splits.

PART THREE – EXECUTION

3.1 PLACING REINFORCEMENT

- 3.1.1 Prior to concreting, place reinforcement, support and secure against displacement, as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.
- 3.1.2 Place reinforcement accurately and secure against displacement by using ties or clips at intersections. Tack welding of reinforcement to secure in place will not be permitted.
- 3.1.3 Secure reinforcement in walls using sufficient spacers on each face to maintain the requisite distance between reinforcement and wall face and so that vertical bars are plumb. Provide spreader bars of minimum size 10M spaced at 2m centers in both directions.
- 3.1.4 Do not drive or force reinforcement into fresh concrete.
- 3.1.5 Set column and wall dowels prior to concreting with wooden templates or other approved means.
- 3.1.6 Where toppings are placed on waterproof membranes, vapour barriers and the like, prevent reinforcement or tie wire contacting these items.
- 3.1.7 Pre-assemble column and beam cages as necessary. Do not "spring" or bend ties and stirrups in order to place longitudinal reinforcement.
- 3.1.8 Pre-tie reinforcement for footings and lower into place so as not to disturb the soil at founding elevation.

3.2 FIELD BENDING

- 3.2.1 Do not field bend reinforcement except where indicated or authorized in writing by Consultant.
- 3.2.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- 3.2.3 Replace bars which develop cracks or splits.

3.3 CONSTRUCTION JOINTS

- 3.3.1 Obtain written approval from the Consultant for location and details of construction joints not shown.
- 3.3.2 Continue reinforcement through the joint in its normal position. Add additional reinforcement across the joint as shown or directed.

3.4 QUALITY CONTROL

- 3.4.1 Provide a system of quality control to ensure that the minimum standards

- specified herein are attained.
- 3.4.2 List the names, qualifications, duties and responsibilities of supervisory and quality control personnel.
 - 3.4.3 Bring to the attention of the Consultant any defects in the work or departures from the Contract Documents which may occur during Construction. The Consultant will decide upon corrective action and give recommendations in writing.
 - 3.4.4 The Consultant's general review during construction and inspection and testing by Independent Inspection and Test Companies reporting to the Consultant is undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.

3.5 NOTIFICATION

- 3.5.1 Prior to commencing significant segments of the work, give the Consultant and Independent Inspection and Testing Companies appropriate notification so as to afford reasonable opportunity to review the work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective.

3.6 INSPECTION AND TESTING

- 3.6.1 The Owner will appoint an Independent Inspection and Testing Company to make inspections or perform tests as the Consultant directs. Inspection and testing shall be paid from a cash allowance.
- 3.6.2 A series of specimens for each grade and size of reinforcing steel contained in any 100 tonnes of steel shipped may be tested. A series of tests will include two bars for each test required of each size and grade of steel used. Reinforcing steel tests will be made in accordance with CSA G30 Series.

3.7 DEFECTIVE MATERIALS AND WORK

- 3.7.1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have additional tests, inspections or surveys performed, in order to determine if work is defective. Tests, inspections or surveys carried out under these circumstances will be made at the Contractor's expense in the event of defective work, or at the Owner's expense where work is in conformance.
- 3.7.2 Materials or works which fail to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

PART ONE - GENERAL

1.1 DESCRIPTION

1.1.1 Work included: Provide all cast-in-place concrete, complete in place, as indicated on the drawings, specified herein, and needed for a complete and proper installation.

1.1.2 Related work described elsewhere:

- .1 Section 03100 - Concrete Formwork and Accessories
- .2 Section 03200 - Concrete Reinforcement
- .3 Section 03345 - Concrete Finishing
- .4 Section 07211 - Insulation

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

1.2.1 Anchors, bolts, hangers, sleeves, ties, inserts and other items required to be cast into concrete are to be supplied by applicable trade.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

1.3.1 All Codes and Standards referred to herein are to be latest edition.

1.3.2 Applicable Codes and Standards governing work of this Section:

- .1 CAN/CSA A23.1 - Concrete Materials & Methods of Concrete Construction.
- .2 CAN/CSA A23.2 - Methods of Test and Standard Practices for Concrete.
- .3 CAN/CSA A23.3 - Design of Concrete Structures.
- .4 CAN/CSA A5 - Portland Cement.
- .5 Ontario Building Code (OBC).

1.4 SOURCE QUALITY CONTROL

1.4.1 Supply concrete from a plant which has membership in the Ready-Mix Concrete Association of Ontario or otherwise approved by the Consultant.

1.5 SUBMITTALS

1.5.1 General: Comply with pertinent provisions of Section 01300.

1.6 INSPECTION AND TESTING

1.6.1 An independent Inspection and Testing Company may be appointed to perform material tests. The costs of testing will be paid, on approval by the Consultant, from the Allowances Section 01020.

1.6.2 Inspection Company shall:

- .1 Approve proposed concrete design mixes, if requested by the Consultant.
- .2 Perform testing in accordance with CAN/CSA A23.2
- .3 Submit complete reports including any abnormal conditions and

explanations if poor results obtained.

- .4 Supply molds for test specimens.

1.6.3 Take concrete tests as follows:

- .1 Record slump for each set of test specimens and perform air test when air entrainment specified.
- .2 When placing concrete under cold weather requirements, take one additional specimen for each test set and store it on site under conditions similar to concrete it represents. Test this specimen at seven days before removing formwork.
- .3 Ship cylinders to Testing Laboratory with complete shipping tags securely wired to cartons and pay costs of cartons and shipping.
- .4 Frequency of tests: Take one set of cylinders for each day's placement and for each 50 cubic meters of concrete placed if daily placement exceeds 50 cubic meters and as further directed by the Consultant.

1.6.4 Contractor shall:

Pay for additional tests, including load tests and/or report on corrective measures due to:

- .1 Changes in materials or proportions of mix requested by Contractor,
- .2 Failure of test specimens to meet requirements,
- .3 Failure of concrete in structure to meet requirements for strength, density, uniformity, protection and curing,
- .4 Using unidentified reinforcing steel or reinforcing steel from non-Canadian Mills.

1.7 COLD WEATHER CONCRETING

- 1.7.1 When atmospheric temperature is at or below 5° C or when there is a possibility of it falling to that limit, place concrete in accordance with requirements of CAN/CSA A23.1 "Cold Weather Concreting" and ACI 306 "Recommended Practice for Cold Weather Concreting."
- 1.7.2 Exercise particular care to ensure that previously placed concrete and reinforcing steel are adequately heated to prevent freezing of new concrete placed directly against it.
- 1.7.3 Exercise care to avoid rapid temperature changes (thermal shock) when removing an area from temporary heating conditions.
- 1.7.4 Remove and replace all concrete damaged by frost or freezing at the direction of the Consultant at no cost to the Owner.
- 1.7.5 Accelerating chemical admixtures shall not be used without the written approval of the Consultant.

1.8 HOT WEATHER CONCRETING

- 1.8.1 When atmospheric temperature is at or above 27° C place concrete in

accordance with CAN/CSA A23.1 "Hot Weather Concreting" and ACI 305 "Recommended Practices for Hot Weather Concreting."

- 1.8.2 Exercise particular care to prevent surface crazing of floor slabs due to combined high temperatures and drying winds.
- 1.8.3 The use of water reducing-retarding chemical admixture in the concrete mix may be required at the Consultant's discretion.

PART TWO - PRODUCTS

2.1 GENERAL

- 2.1.1 Use only materials specified.
- 2.1.2 Use materials in accordance with manufacturer's specifications. Have manufacturer's representative on site when material application is not familiar.

2.2 CONCRETE MATERIALS

- 2.2.1 All materials shall conform to standards specified in 1.3.
- 2.2.2 All cement in below grade concrete shall be moderate Portland cement Type 20. All other cement shall be normal Type 10 in accordance with CSA A5. CSA TYPE GUL Portland-Limestone Cement to be used to reduce CO₂ emissions in concrete.
- 2.2.3 Supplementary cementing materials in accordance with C.S.A. Standards A23.5.
- 2.2.4 Supplementary cement materials to be used to reduce CO₂ emissions in concrete. Maximum supplementary cement materials for suspended slabs on deck and beams is 20% and for slabs on grade is 50% use of slag or 30% use of fly ash, the use of supplementary cement material in slabs on grade also to be coordinated with the finishers. No supplementary cementing materials are permitted for concrete which is to be stained. Refer to Architectural Finish Schedules.

2.3 BONDING AGENT FOR PATCHING MORTAR

- 2.3.1 Daraweld C - W.R. Grace
- 2.3.2 Acrylic Concrete Adhesive - CPD
- 2.3.3 Acrylic Bond - U.S.E. Chemicals
- 2.3.4 Acry-lok by W. R. Meadows

2.4 GROUT, NON-METALLIC, NON SHRINK

- 2.4.1 Masterflow 713 - BASF

2.4.2 In-Pakt – CPD

2.4.3 CG-86 construction grade grout by W. R. Meadows

2.5 WATER REDUCING ADMIXTURE

2.5.1 Pozzolith - BASF

2.5.2 WRDA - Grace Construction

2.6 AIR ENTRAINING ADMIXTURES

2.6.1 MBVR - BASF

2.6.2 NVR - Sternson

2.7 ISOLATION JOINTS

2.7.1 Polyethylene or paint or other suitable inorganic material capable of isolating adjacent placements by acting as a bond breaker.

2.8 VAPOUR BARRIER

2.8.1 Vapour Barrier under slabs shall be in accordance with recommendation of Geotechnical Consultant and Soils Investigation Report or 15 MIL POLY, or as otherwise directed by the Architect in the contract documents.

PART THREE – EXECUTION

3.1 CONCRETE MIX DESIGN CRITERIA & PROPORTIONING OF CONCRETE - PROPERTIES

3.1.1 Design all concrete mixes for the compressive strength and slump requirements in accordance with CAN/CSA A23.1 and as specified in "Proportioning" of this section. Allow for the appropriate coefficient of variation for each strength class for the batch plant supplying the concrete.

3.1.2 Submit detailed mix designs for each class of concrete for review by the Material Testing Consultant at least two weeks prior to the commencement of concreting. Submit up to date statistical data for the batch plant confirming the coefficient of variation for each strength class.

3.1.3 Note that concrete that is to be stained may not have any supplemental cementitious materials in the mix.

3.1.4 Proportion the materials in accordance with the mix designs supplied to provide the following specified design strengths, slumps and air contents.

- 3.1.5 For fibre concrete provide fibres at the rate of 2.2 lbs (1.0kg) per cubic metre of concrete. Provide a compatible slump enhancer to ensure that no slump loss occurs with the addition of fibres.

CONCRETE PROPERTIES

LOCATION	28 DAY COMPRESSIVE STRENGTH (MPa)	WATER to CEMENT RATIO	SLUMP (1) (mm)	AIR CONTENT (2) (%)	CLASS of EXPOSURE
Mud Slabs & Lean Fill	10	--	125	--	N
Underpinning Blocks	20	--	100	--	N
Strip Footings, Isolated Column Footings, Raft Slab Footings ⁽³⁾	25	--	100	--	N
Piers and Columns Isolated ⁽³⁾	25	--	100	--	N
Piers and Columns cast monolithic with walls ⁽³⁾	to match wall concrete				
Piers and Columns Exterior ⁽³⁾	35 ⁽⁶⁾	0.40	100	5~8	C-1
Grade Beams - Exterior	25	0.55	100	4~7	F-2
Grade Beams - Interior	25	--	100	--	N
Walls Foundation - Exterior	25	0.55	100	4~7	F-2
Walls Foundation - Interior	25	--	100	--	N
Walls Shear Wall Exterior Foundation	30	0.55	100	4~7	F-2
Walls Shear Wall Interior Foundation ⁽⁴⁾	30	--	100	--	N
Retaining wall – Exterior	35 ⁽⁶⁾	0.40	100	5~8	C-1
Interior Slabs on Grade	25	0.50 ⁽⁸⁾	100 ⁽¹⁰⁾	--	N
Interior Slabs on Composite Steel Deck	25	0.55 ⁽⁹⁾	100	--	N
Suspended Slabs – Interior ⁽⁷⁾	30	--	100	--	N
Suspended Slabs - Exterior	35 ⁽⁶⁾	0.40	100	5~8	C-1
Housekeeping Pad	20	--	100	--	N
Topping ⁽⁵⁾	30	0.55	100	--	N

Footnotes:

- (1) Concrete slump for all concrete is 75mm plus or minus 25mm unless prior approval for mix and placement procedure is received from the Consultant. Slump shown in table is maximum value prior to addition of water reducing agent.
- (2) If concrete is placed by pumping, addition sampling and air content testing is required at pump discharge.
- (3) Unless noted otherwise in Column and Footing Schedule.
- (4) Refer to shear wall elevations and/or schedules for concrete properties not specified here.
- (5) Toppings less than 100 mm in thickness to have 10 mm maximum coarse aggregate.
- (6) 56-day compressive strength.
- (7) Unless noted otherwise on plan.
- (8) 0.40 for polished concrete areas.
- (9) 0.45 for polished concrete areas.

- 10) Interior slabs on grade to have slump 50-100mm without super P, 125-175mm with super P. For polished concrete floors maximum slump to be 80mm after addition of water Reducing agent.
- 3.1.6 Provide an approved water-reducing admixture in all concrete. (Obtain approval before using during hot weather).
- 3.1.7 Concrete exposed to freeze/thaw conditions shall be air entrained controlled at 5% plus or minus 1%.
- 3.1.8 **Do not use calcium chloride or products containing calcium chloride in concrete.**
- 3.1.9 Maximum size of coarse aggregate shall be 19mm, toppings less than 100 mm in thickness to have 10 mm maximum coarse aggregate.

3.2 INSTALLATION

- 3.2.1 Clean equipment, for mixing and transporting concrete, of hardened concrete and foreign materials before and after use.
- 3.2.2 Place concrete as rapidly and as near as possible to its final position.
- 3.2.3 Transport concrete, from mixer to place of final deposit by methods which will prevent separation or loss of ingredients.
- 3.2.4 Remove debris including ponded water from places to be occupied by concrete prior to pouring.
- 3.2.5 Concrete free fall not to exceed 2m.
- 3.2.6 Concreting once started shall be a continuous operation until placing of section is completed. Do not permit cold joint to develop.
- 3.2.7 Thoroughly consolidate concrete during and after placing by spading and vibrating to work concrete around reinforcement, water bars or other embedded materials. This includes footings.
- 3.2.8 Do not spread concrete horizontally into place by means of vibration.
- 3.2.9 Ensure that finished concrete is dense, uniform, free of air holes and honeycombs and that no segregation of cement paste and aggregate occurs.
- 3.2.10 Maximum time between batching materials and placing concrete is 1.5 hours.
- 3.2.11 Remove snow and ice from hardened concrete or forms with hot air.

3.3 FOOTINGS

- 3.3.1 Place footings on undisturbed soil or engineered fill as outlined on drawings.

- 3.3.2 Construct footing commencing from lowest elevation and proceeding to higher elevations.
- 3.3.3 Form sides of footings. Forms for footings shall be full depth for column footings. For wall footings forms shall be footing depth or less 20mm maximum.
- 3.3.4 Depths of footings called for on drawings are minimum.
- 3.3.5 Concrete shall not be placed until subgrade has been inspected and approved.
- 3.3.6 All footings shall be centered under load bearing elements unless approved otherwise in writing by the Engineer.

3.4 SLABS ON EARTH - Interior

- 3.4.1 All floor on grade shall be as outlined on drawings.
- 3.4.2 Concrete shall not be placed until subgrade has been inspected and approved.
- 3.4.3 Isolate all floors on grade from perimeter walls.

3.5 EXTERIOR SLABS

- 3.5.1 Provide slabs and curbs as detailed on drawings, of 32 MPa concrete.
- 3.5.2 Concrete shall contain entrapped plus entrained air controlled at 5% plus or minus 1%.
- 3.5.3 Place slabs over 150mm deep bed of granular "A".
- 3.5.4 Divide slabs with isolation joints at 6m maximum centers, at edge of building and along curbs. Provide false joints at 2 m maximum centers between isolation joints.

3.6 CUTTING AND PATCHING

- 3.6.1 Break out and make good all temporary openings in concrete work for pipes, conduits, ducts, shoring and other such work during construction using a mix or mortar of the same proportions as the surrounding work and finished to match surrounding work.

3.7 FINISHING OF FORMED SURFACES

- 3.7.1 Exposed surfaces: Immediately after stripping of forms, surfaces shall be inspected before any repairing or surface treatment is started.
- 3.7.2 Concrete members which are patched without approval will be classified as

defective work and may be required to be removed.

- 3.7.3 Remove honeycombed and other defective surfaces down to sound concrete, thoroughly wet, including surrounding areas, and repair with patching mortar containing bonding agents.
- 3.7.4 Producing smooth surfaces by means of cement plaster will not be permitted.
- 3.7.5 Walls shall have fins ground smooth, plastic cones removed and form ties cut back.
- 3.7.6 Fill tie holes with patching mortar containing an approved bonding agent.
- 3.7.7 When forms are removed before concrete is seven days old, cure surfaces immediately.

3.8 MISCELLANEOUS CONCRETE ITEMS

- 3.8.1 Filling In: Fill in holes and openings left in concrete structures for the passage of work of other trades, unless otherwise directed, after the work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling to concrete block lintels, solid courses, beams, etc. to complete the work.
- 3.8.2 Miscellaneous Concrete Work: Provide all miscellaneous foundations, piers and slabs as detailed on the drawings.
- 3.8.3 Concrete for Exterior Curbs and Landscaping: Provide and install curbs and bands of 32 MPa, air entrained and concrete sawcut control joints at 1.5m on centre at corners and depress where indicated.

3.9 REMEDIAL WORK

- 3.9.1 General: Reinforce or replace deficient work as directed by the Consultant and at no additional cost to the Owner.
- 3.9.2 Patching: Repair defective areas and fill form-tie holes and similar defects in accordance with Chapter 9 of ACI 301. Where, in the opinion of the Consultant, surface defects such as honeycomb occur, repair the defective areas as directed by the Consultant.

END OF SECTION

PART ONE - GENERAL

1.1 DESCRIPTION

- 1.1.1 Work Included: Provide all concrete finishing, complete, as indicated on the drawings, specified herein, and needed for a complete and proper installation.
- 1.1.2 Related work described elsewhere:
.1 Section 03300 – Cast-in-Place Concrete

1.2 QUALITY ASSURANCE

- 1.2.1 Standards:
.1 Comply with CAN/CSA A23.1 and the requirements of the Concrete Floor Contractors Association.
.2 In case of conflict between the reference standards, the more stringent requirements shall govern.

1.3 QUALIFICATIONS

- 1.3.1 Only skilled competent workmen, familiar with products and their application shall be permitted to perform work.

1.4 TOLERANCES

- 1.4.1 Allowance shall be from level given on Drawings, as determined by straight edge placed anywhere on the slab in any direction.
- 1.4.2 Finishes with a Class A tolerance shall be true planes within 6mm using a 3m straight edge (1/4" in 10'-0").
- 1.4.3 Finishes with a Class B tolerance shall be true planes within 6mm using a 1m straight edge (1/4" in 3'-0").

PART TWO - PRODUCTS

2.1 MATERIALS

- 2.1.1 Use only materials specified.
- 2.1.2 Use materials in accordance with manufacturer's specifications. Have manufacturer's representative on site when material application is not familiar.

2.2 CURING AND SEALING COMPOUND

- 2.2.1 Acrylic cure and seal - CPD.
- 2.2.2 Clear Seal 150 - Grace Construction Ltd.

- 2.2.3 CS-309-20 by W. R. Meadows.
- 2.2.4 Alternate materials approved equal.

2.3 FILLER IN SAW CUTS

- 2.3.1 Rezi-weld-flex by W. R. Meadows.
- 2.3.2 Loadflex – Sika.
- 2.3.3 Alternate materials approved equal.

PART THREE - EXECUTION

3.1 FLOATING

- 3.1.1 After all bleed water and water sheen has left the concrete surface and concrete is stiffened enough to walk on, mechanically float large open concrete surfaces using a machine fitted with float blades on a steel disc. Shake applied floor hardener is to be applied according to manufacturer's instructions to achieve a uniform surface.

3.2 STEEL TROWELLING

- 3.2.1 Machine or hand trowel concrete to produce a hard, smooth surface.
- 3.2.2 Repeat trowelling, with necessary time intervals in between to allow concrete to further harden until desired finish is achieved.
- 3.2.3 Keep trowel blades relatively flat for initial trowelling, raising blade on angle with subsequent passes.

3.3 GRINDING

- 3.3.1 Where steel trowel finish is not of specified quality, remove ridges, undulations or other imperfections by grinding.

3.4 CURING AND PROTECTION

- 3.4.1 Protection and curing of concrete in accordance with Section 21 of C.S.A. Standard CSA-A23.1.
- 3.4.2 Maintain all equipment and materials for the protection and curing of concrete on site, ready to use before concrete placing is started.
- 3.4.3 Cover walls, piers, columns, beams, and slab edges with wet burlap or tightly wrap with properly lapped 4 mil polyethylene sheeting, immediately after stripping to continue the curing periods. (Surfaces which will not be exposed to

view, or which will not have other surface treatment may be sprayed with curing compound after stripping).

- 3.4.4 Cure horizontal surfaces immediately after finishing operations, but not later than 12 hours, in normal weather, after concrete is placed. Floor and roof slabs shall be kept constantly damp for 14 days by fog spraying or completely covered with wet burlap or 4 mil polyethylene sheeting, properly lapped at side and edge laps and weighted down immediately after finishing, or by the application of Sika FLOR-SEAL or equivalent curing and sealing compound. **Polished** concrete surface shall be completely covered with wet burlap or 4 mil polyethylene sheeting.
- 3.4.5 Cover sidewalks, curbs, gutters, and exterior paved areas with wet burlap or polyethylene sheeting.
- 3.4.6 A sprayed-on membrane curing compound may be used for surfaces listed under paragraph 3.4.3, 3.4.4 and 3.4.5, in lieu of polyethylene sheeting for concrete poured between April 1st and October 14th, except as follows: Floor areas or wall surfaces which are to have topping, **polished** concrete surface or other specialty surface treatments are not to have spray-applied compounds employed but must be polyethylene cured. Coordinate with the flooring contractor to ensure compatibility with flooring adhesives.
- 3.4.7 Freshly finished floors are not to be used for seven (7) days after completion and only light use is permitted for an additional 7 days.
- 3.4.8 Make good cracking and/or reduced strength and/or curling due to concrete drying out too rapidly. Assure that concrete is placed on thoroughly dampened subgrade, except where a poly vapor barrier is used.
- 3.4.9 Protect concrete from harmful effects of heaters, mechanical shock, sunshine, drying winds, cold weather and running or surface water.
- 3.4.10 No materials shall be piled, stored, shovelled or handled on slabs, across slabs, until seven days after placing concrete.

3.5 CONTROL JOINTS

- 3.5.1 Sawcut control joints in slabs on grade. Locate control joints where shown on drawings but in any case of sufficient quantity and at locations to have maximum uncut dimensions of **3.6m** (3.0m for polished concrete surface) in any direction and at all reentrant corners. Cut shall be **3.2mm** wide and one fourth of slab thickness deep. Flush out sawcut immediately with water.
- 3.5.2 Make sawcuts no sooner than 12 hours or later than 24 hours after finishing, depending upon curing conditions. Alternatively, use the "soft" cut technique where directed by the Engineer. Do not fill sawcuts for at least 28 days.
- 3.5.3 After 28 days, clean out sawcuts using brushes and compressed air, removing all dirt and foreign material. Fill sawcuts with specified filler. Finish to match

surrounding surfaces.

3.6 SLABS

- 3.6.1 Top of all concrete floor slabs and toppings shall be steel trowel finished to Class A tolerance, except for floors receiving carpet, tile or quarry tile to be Class B.

END OF SECTION

PART ONE - GENERAL

1.1 RELATED WORK

- 1.1.1 Cast-in-Place Concrete: Section 03300

1.2 REFERENCE STANDARDS

- 1.2.1 All Codes and Standards referred to herein are to be latest edition.
- 1.2.2 Do precast pre-stressed concrete work in accordance with CAN3-A23.4 and CAN3-A23.3.
- 1.2.3 Do welding in accordance with CSA W59 for welding to steel structures and CSA W186 for welding reinforcement.

1.3 QUALIFICATIONS OF MANUFACTURER

- 1.3.1 Manufacturers of precast concrete elements to be certified by CSA requirements of CSA A251.
- 1.3.2 Manufacturers shall be approved by C.M.H.C.

1.4 DESIGN CRITERIA

- 1.4.1 Design precast prestressed concrete units to CAN3-A23.3 and to carry handling.
- 1.4.2 Design loads in accordance with applicable codes for use and occupancy, wind, temperature, and earthquake.
- 1.4.3 Consider vibration characteristics in accordance with NBC.
- 1.4.4 Design prestressed units to meet (2) hour fire resistance rating.

1.5 SOURCE QUALITY CONTROL

- 1.5.1 Upon request, provide Engineer with certified copies of quality control tests and inspection related to project as specified in CAN3-A23.4 and CSA G279.
- 1.5.2 Inspection of prestressed concrete tendons is required in accordance with CSA G279. Upon request, provide Engineer with certified copy of mill test report of reinforcing steel supplied, showing physicals and chemical analysis.

1.6 SHOP DRAWINGS

- 1.6.1 Submit shop drawings in accordance with Section 01340 – Shop Drawings, Product Data.
- 1.6.2 Submit shop drawings in accordance with CAN3-A23.4 and CAN3-A23.3. Upon request the following items shall be provided:
 - .1 Design calculations for items designed by Manufacturer
 - .2 Camber
 - .3 Finishing schedules
 - .4 Methods of handling and erection
 - .5 Openings, inserts and related reinforcement
- 1.6.2 Each drawing submitted to bear stamp of qualified Professional Engineer registered in the Province of Ontario.

1.7 WARRANTY

- 1.7.1 The Contractor hereby warrants that the precast prestressed elements will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with GC24, for a one year period.

PART TWO – PRODUCTS

2.1 MATERIALS

- 2.1.1 Cement, aggregates, water, admixtures to CAN3-A23.4 and CAN3-A23.1, CAN3-A23.1S1, CAN3-A23.1S2.
- 2.1.2 Prestressing steel: Uncoated 7 wire cable conforming to CAN/C.S.A.-S6 and CSA G279.
- 2.1.3 Reinforcing steel: To C.S.A. G30.12.
- 2.1.4 Anchorages and couplings: To CAN3-A23.1, CAN3-A23.1S1, CAN3-A23.1S2.
- 2.1.5 Embedded steel: To CAN/C.S.A.-G40.21, Type M300W.
- 2.1.6 Welding materials: To C.S.A. W48.1.
- 2.1.7 Bearing pads: 3mm masonite smooth one side.

2.1.8 Insulation: Expanded polystyrene to CAN/CGSB-51-20.

2.1.9 Air entrainment admixtures: To CAN3-A266.1.

2.1.10 Chemical admixtures: To CAN3-A266.2.

2.2 CONCRETE MIXES

2.2.1 Use concrete mix designed to produce 41 MPa (6000 psi) compressive cylinder strength at 28 days with maximum water/cement ratio to CAN3-A23.1, Table 7 for Class D exposure, CAN3-A23.1S1, CAN3-A23.1S2.

2.2.2 Air entrainment of concrete mix: To CAN3-A266.4.

2.2.3 Admixtures: To CAN3-A266.4, CAN3-A266.5.

2.2.4 Do not use calcium chloride or products containing calcium chloride.

2.3 GROUT MIX

2.3.1 Cement grout: One part type 10 Portland cement 2-1/2 parts sand, sufficient water for placement and hydration.

2.4 MANUFACTURE

2.4.1 Manufacture units in accordance with CSA 251.

2.4.2 Mark each precast unit to correspond to identification mark on shop drawings for location on part of unit which will not be exposed.

2.4.3 Provide hardware suitable for handling elements.

2.4.4 Provide 50mm (2") thick insulation plug at each cell end of hollow core at exterior.

PART THREE – EXECUTION

3.1 ERECTION

3.1.1 Erect elements within allowable tolerances indicated or specified.

- 3.1.2 Non-cumulative erection tolerances in accordance with CAN3-A23.4, Section 10.
- 3.1.3 Install 3mm masonite bearing pads, smooth side up on bearing ends, of concrete or masonry.
- 3.1.4 Set units in a tight, level position on true level bearing surface provided by others, Minimum bearing 90mm (3 ½") on masonry and 75mm (3") on structural steel.
- 3.1.5 Fasten precast units in place as indicated on reviewed shop drawings.
- 3.1.6 Level differential elevation of horizontal joints with grout to slop not more than 1:12
- 3.1.7 Clean field welds with wire brush and touch up with primer.
- 3.1.8 Field cut holes and openings up to 150mm (6") diameter for mechanical trades. Openings larger than 150mm (6") to be located on shop drawings at time of approval and to be cut in field. Do not cut reinforcing without approval of precast slab manufacturer and Engineer.

3.2 TOPPING

- 3.2.1 This contractor shall provide a suitable top finish to accept direct application of finished flooring/roofing as per room finish schedule.
- 3.2.2 Where concrete topping (Minimum 37mm [1 ½"]) is to be applied use 30MPa, peastone concrete. The top surface of the precast prestressed slabs is to be raked (roughened) for bonding of topping.

3.3 EXPOSED CEILINGS

- 3.3.1 Caulk exposed ceiling longitudinal joints, using standard caulking.
- 3.3.2 The underside of precast shall be finished ad per C.S.A. A23.4 (24.2.2) STANDARD FINISH.

3.4 CLEAN-UP

- 3.4.1 Upon completion of the work of this section, all surplus material and debris shall be removed from this side.

*Items relating to precast prestressed slabs to be carried out by other trades, and covered in their respective specifications:

-
- (1) Dry packing of gap between precast prestressed slabs at all locations where load bearing walls are parallel to length of slab.
 - (2) Perimeter caulking.
 - (3) Electrical holes.
 - (4) Concrete topping 30MPa pea-stone concrete depth as per drawings. Apply slurry bonding agent (ACRY-LOK™ Acrylic Polymer Admixture by W.R. Meadows or approved equal) to manufacturer's recommendations prior to pouring topping.

END OF SECTION

1 GENERAL

1.1 General Requirements

1.1.1 Conform to Sections of Division 1 as applicable.

1.1.2 Refer to Structural Drawings for concrete finishes notes.

1.2 Special Protection

1.2.1 During construction, protect finished surfaces from abrasion by foot and wheel traffic. Ensure that work of this Section and other Sections incorporating the use of oils and other deleterious materials, are not performed on finished areas, unless finished areas are fully protected by approved covers. Co-operate with other trades to ensure finished work will not be damaged.

1.3 Qualifications of Applicator

1.3.1 Work of this Section shall be performed by an approved, established floor finishing company having a proven record of satisfactory workmanship for a period of at least 5 years.

1.3.2 Have representative of the manufacturer present during the application of the floor finishing materials to ensure proper procedure is adhered to.

1.4 Maintenance Data

1.4.1 Provide instruction manuals for proper procedures to be taken in the cleaning maintenance of concrete floors which are to be left exposed in the finished Work, for incorporation into Maintenance Manual.

2 PRODUCTS

2.1 Materials

2.1.1 Concrete materials to Section 03 33 00 - Cast-In Place Concrete.

2.1.2 Curing compound: Exterior Concrete Paving
"Seal Cure-25" as manufactured by W.R. Meadows or equal.

2.1.3 Interior exposed concrete surfaces, acrylic sealing compound
"TIAH OTC" as manufactured by W.R. Meadows or equal.

2.1.4 Non-slip Interior exposed concrete surfaces, water-based, acrylic slip resistant additive,

"Deck-O-Grip W/B" as manufactured by W.R. Meadows or equal.

2.1.5 Water: potable water

2.1.6 Cleaners, thinners and accessories: type recommended by manufacturer for purpose intended.

3 EXECUTION

3.1 General

3.1.1 Work in close co-operation with Section 03 33 00 during casting of concrete. Immediately after floor slabs and decks have been cast, begin finishing by screeding slabs to proper shape and elevation, bull and machine float, and steel trowel to produce smooth, dense surfaces free from ridges, voids and machine marks in accordance with applicable requirements of CSA-A23.1-14.

3.1.2 Float surfaces and avoid bringing water and fines to surfaces by over floating. Repeat operation after time interval necessary for any sheen to disappear and concrete to set further.

3.2 Workmanship

3.2.1	Remove all exposed macro-fibre reinforcing at surface of finished slab by sanding, burning and/or shotblasting as required for floor finishes.

3.2.2 Steel trowel concrete slab to be left exposed or to receive resilient flooring, carpeting, floor hardeners.

3.2.3 Screed off new concrete slabs to receive ceramic and quarry tile, to true lines and levels shown and leave ready to receive finish. Depress slabs to accommodate finish.

3.2.4 Where floor drains occur, finish floors straight and level at walls and provide minimum 5 mm per m (1/16" per foot) uniform pitch to drains, unless indicated otherwise.

3.2.5 Provide shelf type dividing strips at junction of exposed concrete floors and ceramic tile. Centre dividing strips under centerline of doors where this condition occurs, unless indicated otherwise. Install dividing strips in true, straight lines and flush with finished floor and shelf set at correct depth to receive ceramic tile floor finish.

3.2.6 Completed surfaces shall not vary more than 6 mm in 3,000 mm (1/4" in 10'-0") from dead level except where slopes, and slopes to drains are required.

- 3.2.7 Float surface with wood or metal floats or with power finishing machine and bring surface to true grade.
- 3.2.8 Unless otherwise specified, steel trowel to smooth and even surface to within 3 mm (1/8") tolerance when measured in any direction using 3 m (10 ft.) straight edge.
- 3.2.9 Provide additional steel trowelling where concrete slab is to be left exposed.
- 3.2.10 Apply wood float finish to areas to be covered with ceramic tile.

3.3 **Floor Finish - General**

- 3.3.1 Finish concrete in accordance with CSA A23.1, Class A.
- 3.3.2 Do not sprinkle dry cement or dry cement and sand mixture over concrete surfaces.

3.4 **Curing**

- 3.4.1 Commence curing operations immediately after finishing has been completed.
- 3.4.2 Cure concrete in accordance with CSA-A23.1 except where specified otherwise.
- 3.4.3 Unless otherwise specified cure concrete surfaces by covering with burlap, geotextile fabric, or 4 mil polyethylene sheeting, lapped and sealed with tape at joints, and firmly anchored in place; leave covering in place for at least 7 days. Ensure concrete is kept continuously moist during curing period.
- 3.4.4 Apply curing compound to concrete surfaces as recommended by manufacturer.

3.5 **Crack Repair**

- 3.5.1 Prior to completion of the project and in any case not sooner than 28 days after concrete has been placed, examine concrete floor surfaces and repair all major cracks in them. Rout cracks out with mechanical router. Leave cracks clean.

3.6 Schedule

Following curing methods and finishes shall be applied to the corresponding surfaces:

<u>SURFACE</u>	<u>CURING METHOD</u>	<u>CONCRETE FINISH</u>
Interior exposed concrete floors (sealed concrete)	Single application sealer Use slip-resistant sealer where indicated.	Steel trowel
Concrete to accept porcelain tile floor	Wet Cure	Wood float finish
Concrete to accept epoxy, carpet or sheet flooring	Wet cure	Steel trowel
Concrete sidewalk and curbs	Curing compound	Coarse bristle brush

***** END *****

1. GENERAL

1. GENERAL REQUIREMENTS

1. Division One - General Requirements is a part of this Section and shall apply as if repeated here.

2. REFERENCE STANDARD

1. Do masonry mortar and grout work in accordance with latest CSA A179-M1994 edition except where specified otherwise.

3. SAMPLES

1. Samples of coloured mortar will be evaluated when built into mock-up wall. Three colours to be built into mock-up for exterior masonry mock-up for the Architect's review.

2. PRODUCTS

1. MATERIALS

1. Masonry Cement: Conform to requirements of CAN/CSA-A8-M93, Masonry Cement.
2. Sand: Conform to requirements of C.S.A. A82.56-M1976 "Aggregate for Masonry Mortar".
3. Water: Potable, free from injurious or other substances detrimental to mortar, or will cause efflorescence.
4. Portland Cement: Conforming to CAN/CSA-A5-M88, white or grey as indicated.
5. Hydrated Lime: Conforming to ASTM C207-79 "Specifications for Hydrated Lime for Masonry Purpose" Type S. Hydrated lime shall be "soaked" 48 hours before paste is mixed with sand.
6. Mortar Colour: Pigment type as supplied by Harcott Pigment Ltd., or approved equal colour to match masonry. Allow for three (3) colours at exterior areas where three (3) colours of masonry are used. Colour admixture not to exceed 10% of cement content by mass.
7. Use of any admixture to meet cold weather requirements is expressly forbidden.
8. 1:1:6 Masonry Mortar for Clay Brick: equal to 1:1:6 Type "N" mortar.

2. MORTAR TYPES

1. Mortar types shall be as designated and conform to latest C.S.A. A179-M1994 edition, "Mortar and Grout for Unit Masonry".
2. The following mortar types shall be used:
 1. For masonry foundation walls and masonry in contact with earth - Type S.
 2. For interior block unit masonry above grade - Type S unless noted otherwise on plans.
 3. For clay brick masonry exterior (exposed) block veneer, quarried stone and glazed block - 1:1:6 Type "N" mortar.
 4. For structurally reinforced masonry walls - Type "S".

3. GROUT

1. To current CSA A179-M1994 standard.
2. The following grout types shall be used:

<u>Type</u>	<u>Fine Grout</u>	<u>Coarse Grout</u>
Portland Cement - cu. ft.	1	1
Hydrated Lime (optional cu.ft.)	1/10	1/10
Damp Loose Sand - cu. ft.	2¼ to 3	2¼ to 3
Pea Gravel - cu. ft.	-----	1 to 2

Water - only enough to give creamy pouring consistency. Use a 1 cu. ft. (or metric box) in measuring portions for use in bond beams, lintels, and vertical cells.

3. Low lift grout as per structural drawings.
4. Grout Masonry components where indicated.

4. PARGING

1. Parging Mortar: Type M to latest CSA A179-M1994.

3. EXECUTION

1. MIXING

1. Mortar used in the construction of unit masonry walls shall conform to C.S.A. A179-M1994.

2. Material proportions, acceptable compressive strengths, locations of use, incorporation of admixtures included in C.S.A. A-179-M1994, shall be modified as may be required by Jurisdictional Authorities.
3. Mix premixed 1:1:6 mortar as in strict conformance with directions provided by the manufacturer.
4. All grouting to conform to the requirements of CSA Standard CAN3-A371-M84.

2. MIXING OF COLOURED MORTAR

1. Premix colouring agents with dry cement in large batches (for best control) in strict accordance with pigment manufacturer's instructions, accurately measured to ensure constant and even colour of mortar throughout the job. Submit mortar colour "recipe" in operations and maintenance binders.
2. Maintain sufficient mixers on job site, one for regular mortar and one for each coloured mortar exclusively.
3. Three colours of mortar at exterior masonry may be selected by Architect at areas where three colours of masonry are used. Colours as selected by Architect.

3. TESTING

1. Testing of mortar materials will be carried out by testing laboratory designated by Architect.
2. Submit samples of sand and water for testing to ensure that mortar will not produce efflorescence.
3. Submit samples of sand and water and premixed mortar for testing to ensure that mortar will not produce efflorescence.
4. Mortar shall be tested in accordance with the requirements of clause 4.4.1 in CSA S304.1-94 and CSA A179-94.
5. Testing shall be completed for each 250 m² of masonry, for each storey.

END OF SECTION

1. GENERAL

1. GENERAL REQUIREMENTS

1. Division One - General Requirements are part of this section and shall apply as if repeated here.

2. REQUIREMENTS OF REGULATORY AGENCIES

1. Conform to the latest Ontario Building Code, as currently amended and Local Bylaws, except where indicated otherwise on drawings or specified herein. In case of conflict between Codes, the Ontario Building Code will govern.

3. STANDARDS

1. Materials, equipment, and practice shall conform to CSA3-S304-04 and CSA-A371-04, Masonry Code of Practice and CAN/CAN/CSA-A82-06 for masonry. Masonry units must comply to CAN3-A82.2 M78 and concrete masonry units shall comply to CSA A165 Series-14. Masonry units must not have a greater Saturation Coefficient than .78 as set by test method CAN3-A82.2 M78 and must meet specifications CAN/CAN/CSA-A82-06 for SW grade FBX type masonry. Masonry units will be tested once they are delivered to the site and shall not be installed until testing is complete and units have surpassed the tests.
2. Work of this section to comply with "Plain and Reinforced Masonry-Canadian Structural Design Manual" Supplement to the National Building Code of Canada and CSA-A371-94.
3. Ensure fire rated walls, partitions or separations are in accordance with "Fire Performance Ratings Supplement" of the National Building Code of Canada.

4. SAMPLES

1. Construct 3'-0" (900 mm) high by 6'-0" (1800 mm) long wall with 3'-0" (900 mm) long corner return sample masonry wall on site (may be part of final wall construction). Construct one cavity wall panel of the types masonry specified. Construct with mortar, masonry specified and approved by the Architect, to show colour range, texture, banding, bond, and flashing, joint reinforcement, flashings, membrane flashings, cavity insulation, air vapour/barrier system, weepers, and mortar joints. Construct as many times as required to provide a wall to the satisfaction of the Architect, before commencing masonry work. Prepare similar panels for approval using, acoustical sound block, and all other architectural block types specified.
2. Remove rejected sample walls. Protect approved sample wall from damage and retain in place through duration of project until removal is

directed by Architect.

3. Only masonry matching approved sample walls in all respects will be accepted for work of this project.
4. Submit masonry samples for architect's choice of colour prior to ordering materials and constructing the sample wall.

5. DELIVERY AND STORAGE

1. Stockpile masonry units on platforms or other approved supports to keep units free from ground contact. Prevent staining of masonry units from contact with any material while stored. Secure waterproof covering entirely over each stockpile when masonry work not in progress.
2. Deliver, handle and store masonry units by methods which will guard against soiling or chipping. Protect all holes and reglets from water and ice during freezing weather.
3. Dry out units which fail to meet moisture content limitation during storage on job site and do not lay until tests prove satisfactory.

6. SPECIAL PROTECTION

1. Protect exposed masonry corners and projections by methods which will not mar finished surfaces.
2. Masonry stained or damaged shall be replaced as directed by Architect.
3. Cover tops of all walls with well-secured, approved, non-staining and waterproof material while work is not in progress and until satisfactorily covered by metal deck structure or roof membrane. Cover shall be at least 2'-0" (600 mm) wider than width of wall.
4. In cold weather protect masonry and heat materials as provided in CSA-A371-94 and "Recommended and Guide Specifications for Cold Weather Masonry Construction" available through Ontario Masonry Contractors Association. Maintain dry beds for masonry and use dry masonry units only. Do not wet masonry units in winter.
5. In hot weather, protect freshly laid masonry from drying too rapidly by means of waterproof, non-staining coverings.

7. SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 01300 - Shop Drawings, Product Data, Samples and Mock-ups.
2. Show all interior and exterior wall elevations indicating all control joints and

expansion joints.

3. Submit shop drawings of masonry ties stamped by a professional engineer licensed in the Province of Ontario.
4. Submit samples and shop drawings for Bent Metal Closures and Compartment Control Joints (CCJ).

8. DEFECTS DEFINED

1. In addition to non-compliance with specified requirements or other contract requirements, the following will be considered defects:
 1. shrinkage in individual units and erected work;
 2. spalling;
 3. poor colour of texture blending of units;
 4. surface deterioration, dusting;
 5. discolouration, crumbling and similar deterioration of mortar;
 6. failure of built-in items to remain anchored;
 7. chipped units - any chipped area on exposed surface.

9. EXTRA MATERIALS

1. Provide the following extra number of masonry units of each type of unit as follows. Store in building at job completion.
 1. Architectural Concrete Masonry - 10 units each colour
 2. Stone Masonry – random sizes in quantity to provide 2m² wall area.

10. ADDITIONAL CONCRETE BLOCK:

1. Include in base tender sum labour and material for an additional 20 m² of 190mm block installed for items not indicated on drawings or found field conditions on site or as directed by Architect.

2. PRODUCTS

1. MATERIALS

1. Water: Clean, free from salts that will cause efflorescence and other substances detrimental to masonry.
2. Dampproof Coursing and Base Wall Flashing: Blueskin TWF by Bakor, ensure membrane is supported on a slope, where there is no support, pre-fin. metal TWF to be installed than Blueskin TWF over top and seal.
3. All Thru Wall Flashings / Drip Flashings: Refer to Section 07 62 00 for material. Flashings are to be formed and installed where the word 'flashing', or 'metal flashing', or pre-fin. Metal flashing' are indicated on the drawings to

suit flashings above window and door heads, at low roof high wall, at bellows, closures and waterstops locations, below window sills, etc. Cover top of flashing with Bakor Blueskin TWF membrane reinforced flashing at all locations by this section sealed to wall sheathing 200mm minimum or in reglet in concrete block, both sealed.

Flashings are required at all locations where there is no continuous structural or rigid insulation support, especially at cavity locations.

4. Pre Fin. Metal Flashing Colour: to match adjacent material colour, i.e.;
 - below siding to match siding colour
 - above masonry wall to match masonry wall colour
 - below roofing to match roofing colour
5. TWF Membrane / Base Membrane / Rein. Flexible Membrane Base Flashing: Henry Blueskin TWF membrane reinforced flashing at all locations with "Air Bloc 21 & 21FR" by Henry. Install at base of exterior walls, below window sills; and below all metal flashing locations above low roofs at high wall locations, over top of all pre-fin. metal flashings above windows, doors, low roof high wall locations, etc.
6. Sealant: Tremco Dymeric 240 as per Section 07900.
7. Asphalt Emulsion: Conform to CSG-37-GP-2M.
8. Joint Filler: purpose-made elastomer to ASTM D. 2240-81 of size and shape.
9. Control Joint: "RS Series – Rubber Control Joint", sizing to suit masonry widths as required as manufactured by Hohmann & Barnard Inc. or approved equal.
10. Masonry Weep Holes and Vents: "QV – Quatro-Vent" weep hole ventilator as manufactured by Hohmann & Barnard Inc. (colour to match mortar colour and as selected by Architect).
11. Joint Reinforcement:
 1. Exterior Walls: Fero or Blok-Lok Ltd. stainless steel Block / Stud Shear Connector Plates and V-Tie in combination with ladder type continuous joint reinforcing by Hohmann & Barnard Inc. The Block / Stud Shear Connector Plate length shall suit concrete block (inner wythe) / stud width and thickness of insulation. The Fero V-Tie shall be of length to provide placement of V-Tie legs at centreline of veneer (outer wythe). Provide Block Shear Connector Plate Ties at 400 mm horizontal x 600 mm vertical spacing minimum or as noted on drawings. All components shall be stainless steel in accordance with ASTM 79 - AISI Type 302 & 304.

Heavy Duty Rap Tie with V-Tie legs may be substituted for the Stud Shear Connector noted above along with above / below grade to

poured in place concrete substrates.

Block-Lok BL-5407 can be used below grade to poured in place concrete substrates

2. Below Grade Walls: 3/16" (4.7mm) diameter ladder design stainless steel joint reinforcement at all below grade block walls by Hohmann & Barnard Inc. or Blok-Lok Ltd.
3. Interior Walls: 9 ga. (3.66mm) ladder design mill galvanized joint reinforcement at all interior walls as manufactured by Hohmann & Barnard Inc. or Blok-Lok Ltd.
4. Sizes: 2" (50 mm) less than wall thickness.
5. Rod Size: Side rods 3/16" (4.7mm) and cross rods 3/16" (4.7mm) unless noted otherwise.
6. Provide prefabricated tees and corners at all locations.
7. Masonry Piers: 2" (50 mm) wide stainless steel ladder masonry reinforcing. The masonry shall be tied back to the block with stainless steel "Zee" ties.
12. Nailing Inserts: 26 gauge hot dipped galvanized steel 1" x 2¼" (50 mm x 55 mm) all metal wall plugs.
13. Galvanizing: In conformance with ASTM A153 Class B2.
14. Dovetail Anchor Slots and Ties (poured in place concrete): stainless steel dovetail anchor slots with minimum 9 gauge dovetail triangle ties by Hohmann & Barnard Inc. or Block-Lok Ltd.
15. Masonry Angle Support / Shelf Angles & other angle supports:
Fero Fast (Fero Angle Support Technology)
Hot dipped galvanized with angle support depth to match / work with insulation thickness required.
16. "Z"-Tie: 3/16" (4.76mm) diameter "Z" Tie. See Structural Drawings for details. Provide galvanized finish at interior wall locations and stainless steel at exterior wall locations.
17. Individual Column and Wall Columns: Hot dipped galvanized. For details see structural drawings.
18. Concrete Masonry Units: Standard Weight and Lightweight Units
 1. The following concrete masonry units are to be Carboclave masonry units as manufactured by Boehmers or Day & Campbell:

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1. Standard Weight Concrete Masonry Units: to CSA-A165.1.
 1. Classification: H/20/A/M.
 2. Size: CCMPA metric modular. Sizes as indicated on the drawings.
 2. Lightweight Concrete Masonry Units: to CSA-A165.1.
 1. Classification: H/20/C/M.
 2. Size: CCMPA metric modular. Sizes as indicated on the drawings
 3. 75% Solid & Solid Concrete Masonry Units: to CSA-A165.1.
 1. Classification: S/20/A/M.
 2. Size: CCMPA metric modular. Sizes as indicated on the drawings
 4. Bull Nose Cornering:

For concrete block (other than architectural concrete block) all vertical exposed outside corners and door jambs shall have a 1" (25 mm) radius and window jambs shall be pencil round radius. Provide square edge block for first course above finished floor and pencil round edge from the base course on. Round off the edge of first block course above the top of the base to match bull-nosed edge of other courses.
19. Brick Masonry Units:
1. Provide full size sample of at least 6 colours to Architect for final colour selection prior to ordering. Follow manufacturer instructions and guidelines for installation and basic care.
 1. "Masonry Veneer":

Base Bid for Masonry Veneer to be as follows:

 1. Manufacturers: Brampton Brick, Canada Brick, Hanson, Endicott Clay Products
 2. Classification: CAN/CAN/CSA-A82-06 for SW grade FBX type brick and CAN/CSA-A82-06 testing
 3. Size: To match adjacent Theatre
 4. Colour: To match adjacent Theatre
 5. Product: Face Brick

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20. Architectural Concrete Masonry Units:
1. Architectural Concrete Block (veneer at base exterior wall)
1. Manufacturer: Brampton Brick
 2. Size: CCMPA metric modular, nominal 7-1/2" (190mm) x 15-5/8" (390mm) x 3-1/2" (90mm)
 3. Colour: Ebony Quartz
 4. Product: Finesse
21. Architectural Precast Parapet Cap / Sill
1. Precast Parapet Cap to size and configuration as indicated on drawings.
 2. Precast Sill to size and configuration as indicated on drawings.
22. Cavity Wall Insulation:
1. See Section 07 21 40 for installation execution requirements.
23. Building Paper Felt: 30 lb. building paper felt, (13600 g.).
24. Grouting and Steel Reinforcement for Vertical Reinforced Masonry (VRM): Grouting and reinforcement steel to be supplied and installed by this section. All materials and installations to conform to structural drawings and specifications. Provide a mechanical device to hold vertical reinforcement at centres of block cores.
25. Cavity Closures: 12 gauge 304 stainless steel with 2B finish cold rolled formed to suit continuous bent closure profile:
- around all window and curtain wall openings;
 - around all door openings,
 - around all other misc. openings through exterior cavity wall
 - at expansion joints and control joints
- Closure(s) to have minimum dimensions to meet or exceed cavity wall insulation thickness / depth on both flanges. Do not over exceed insulation and air space cavity dimensions as to block off drainage and air space, this is to remain free of infill to breathe and drain.
26. Compartment Control Joint (CCJ): 12 gauge 304 stainless steel, 2B finish cold rolled formed, complete with ss reinforcing wire @ 400 o/c through slotted holes.
1. Exterior wall locations. Install CCJ at:
 1. All exterior corners, 300mm from corner on both sides;
 2. All interior corners
 3. Max. 20m horizontally on walls and wherever indicated on the drawings.

27. Cavity Mortar Stop Mesh: equal to "Mortar Net" 1" (25mm) thick x 10" (250mm) height 90% open mesh of high density polyethylene.

28. DATE STONE

2. Contractor to install engraved date masonry as part of base bid contract.
3. 400mm x 600mm x 90mm with blackened New Times Roman lettering 250 mm height. Engraving, location to later instruction. Allow for four letters. Exact size to fit coursing to suit masonry veneer wall located within.
4. Contractor to supply and install date masonry where directed by Architect.

3. EXECUTION

1. ERECTION

1. General Workmanship

1. Install unit masonry work in complete conformance to governing requirements of Jurisdictional Authorities.
2. Lay face work from face side. Perform work by skilled mechanics according to best standard practice.
3. Lay masonry level, true to line, square, plumb, and as detailed. Vertical joints in perpendicular line.
4. Distribute exposed masonry of varying colours, tones and textures, evenly over wall surface to avoid patches and streaks and to produce a homogeneous blend. Avoid using units that are too contrasting in appearance for satisfactory blending.
5. Chipped or blemished units may only be used where concealed. Defective and broken units shall be rejected.
6. Make joints uniform in size and tool to match sample joints. Unless specified or indicated otherwise tool all interior joints whether or not they are behind cabinets or fitments or drywall. Close all cracks and crevices. Strike off flush all joints in unparged masonry covered by earth. Press in flush joints at exterior cavity side of inner block wythe so no voids occur. No mortar shall protrude from joints on wall surfaces to which insulation and waterproofing are to be applied. Rake out joints at juncture of masonry walls and columns on exterior and interior, as necessary to permit caulking

detailed or specified, in walls to be plastered upon directly to provide bond, and where otherwise noted on drawings.

7. Fill all joints completely with mortar including webs. Buttering corners of units, throwing mortar scraping into joints, slushing, deep or excessive furrowing of bed joints not permitted. Do not shift or tap units after mortar has taken initial set. When work is resumed on walls previously laid, and which are either partially or totally set, remove all loose masonry and mortar from top and adjoining surfaces. Remove mortar completely when masonry is removed and replace with new.
8. Brace walls and piers during construction until structure provides sufficient lateral support.
9. Extend masonry walls to underside of structure above unless indicated otherwise. Cut and fit masonry work as required. Install anchors at top of masonry to provide lateral support, to Structural Consultant's approval. Fill space at block walls at underside of steel deck solid to conform to code and at all interior partitions and at fire separations. Install formed metal closures where top of block and bottom of metal deck is exposed.
10. Build in steel lintels, base plates and wall plates, as specified in Division 5 and reinforced concrete lintels as specified in Division 3. Set steel lintels in a bed of mortar. Install steel reinforcement and grouting as noted and detailed on structural drawings.
11. Install hollow metal door frames with lintels where specified in masonry walls, in accordance with manufacturer's instructions to present a rigid, true, plumb installation.

Note: Completely fill frames with mortar. Keep faces of frames free of mortar during installation and leave clean. Maintain protective coverings.
12. Build in water stops, bellows, bent closures, sheet metal flashings, accessories, access panels, and anchors required for frames, guards, sills, etc., and as otherwise provided in other sections. Cooperate in the setting and aligning of this work.
13. Work shall include damp-proof coursing and membrane reinforced flashing at base flashing as detailed.
14. Consult other trades (including Athletic Equipment Section 11500) and make necessary provisions to permit the installation of their work in a manner to avoid cutting, patching and fitting.
15. Supply and locate dovetail anchor slots in time for placing in

concrete formwork at locations where masonry walls abut concrete and where anchorage is required. Install slots at 2'-0" (600 mm) on centre horizontally and install joint reinforcement ties at 16" o.c. vertically.

16. Where flashing, membrane reinforced flashing or waterproofing turns out and terminates in horizontal mortar joints at lintels, shelf angles, spandrels, bases and bottom of cavities in cavity walls, provide clear, free draining weep holes in the mortar joints of outer wythes at 32" (800 mm) apart horizontally.
17. Chases shall be built, not cut.
18. Bearings and piers required for structural members shall be constructed as indicated on structural drawings.
19. Cut masonry, blocks, and masonry to be used in exposed walls with carborundum saw and as per manufacturer's instructions.
20. Where low roof meets high wall leave out one masonry unit every 8'-0" o.c. at weep hole level at locations to be selected by Architect. At the appropriate time, this Contractor shall bring this matter to the architect's attention. These masonries are to be mortared in only when authorized by the architect.
21. A water test will be held by the Architect. This Contractor is to supply hose and water for this test upon Architect's request and carry out test under Architect's directions.
22. Install cavity mortar stop mesh 10" (250 mm) in height in bottom of air cavity space at all cavity wall locations and tops of all lintels or flashing at doors, windows and high wall low roof locations.

2. Concrete Masonry Workmanship

1. Lay out work to minimize cutting of units.
2. Use power driven abrasive disc for coping units and splitting units, or for cutting units to accommodate flush mounted electrical outlets, grilles, pipes, etc. Leave 1/8" (3 mm) clearance between edge of item and opening in masonry unit.
3. Use solid unit where bonding is required if webs of hollow blocks do not align one over the other.
4. Concrete masonry units will be rejected if face blemishes, smears or slicks appear whether wall is painted or not. Do not use chipped block where exposed to view.

5. KEEP ALL CAVITY SPACES FREE OF MORTAR IN CAVITY WALLS.
 6. Use blocks with 1" (25 mm) radius vertical edges for external corners including door jambs and pencil round at window jambs. At bottom block course where quarry tile base is to be installed, install square edge outer corner block at first course for quarry tile installation and grind block external corner edge round to 1" (25 mm) radius above quarry tile base to top of first course.
 7. Where beams or lintels bear on concrete block walls, the blocks under the bearing shall be solid or filled with concrete for a depth of two courses and a width of 32" (800 mm) or as noted otherwise.
 8. Where joists bear on hollow masonry walls provide minimum 5½" (140 mm) solid masonry under joist bearing, where concealed masonry may be masonry.
 9. Provide reinforced block lintels (where steel lintels are not indicated on Structural drawings):
 1. over square head openings where noted and at all other locations as detailed on structural and architectural drawings.
 2. over openings not exceeding 5'-0" (1500 mm) where no other support is shown, fill lintels solid with min. 3000 p.s.i. (21 m.p.a.) concrete and reinforce with min. two #5 steel bars;
Note: Conform to structural drawings for bond beam reinforcing and concrete detailing
 3. cast lintels at least 7 days before setting; provide bearing at ends as detailed on structural drawings min. 8" (200 mm).
 10. Where walls 12" (300 mm) and thicker have exposed face on both sides, lay block using two units in wall thickness.
 11. Exposed joints shall be concave unless indicated otherwise.
 12. Use lightweight concrete units for all exposed interior walls.
 13. Provide all structural work at masonry walls as indicated on structural drawings.
3. Architectural Block Veneer Workmanship
1. Lay all masonry units as detailed on drawings. Vertical and horizontal joints shall be 10 mm.

2. Fill the entire space between facing and back-up units with mortar. Keep all cavity spaces free of mortar in cavity walls.
 3. Joints shall be tooled concave or as directed by Architect.
 4. Do not use chipped face unit where exposed to view.
 5. At some openings, units will have to be cut to fit at sills and lintels to suit coursing. See drawing details.
 6. All architectural concrete block mortar joints (cladding/veneer) shall line up with other concrete block mortar joints where abutting.
 7. All architectural concrete block (cladding/veneer) mortar joints shall line up with concrete block wall mortar joints behind.
4. Damp-proof Course
1. Lay dampproof course over tops of all foundation walls. Lap strips a minimum of 4" (100 mm) at junction and angles and install sealant to secure joints.
 2. Install dampproof course at floor level for all interior partition walls on floor slabs on grade
5. Flashings
1. All Thru Wall metal flashings that are unsupported by a rigid item, shown or required built into walls to be 16 oz./sq. ft. (3.15 kg/sq. m.) pre-fin. metal unless indicated otherwise.

All Thru Wall flashings that are supported can be Bakor thru wall flashing membrane.
 2. Install metal wall flashings above structural supports, where low roof meets high walls projecting above; to support membrane reinforced flashing where it would cross a cavity and be unsupported; above windows; above doors; and where indicated on drawings.
 3. Unless otherwise shown, flashing extends through exterior wythe of masonry and carried 8" (200 mm) minimum up the exterior face of interior wythe. Terminate top edge of flashing 3/4" (19 mm) inside a horizontal mortar joint. Rake joint.
 4. All metal wall flashings shall be placed to direct any moisture to the exterior of a wall (slope mortar below) and step flashing

vertically to form a positive dam, with outside edge set in a mineral colloidal asphalt emulsion Type 2 or equal. Ends of all metal flashings to have a 1" (25 mm) up turn at ends to direct moisture to the exterior of the wall.

5. All formed pre-fin. metal flashings to be preformed to shape shown on drawings. Drip to be ¼" (6 mm) at 45 degrees F. (7.2 degrees C.) at exterior face of masonry, except flashings at lintel ends to be trimmed flush. Lap seams 6" (150 mm) with three (3) or more beads of sealant between pre-fin. metal.
6. Cover entire top side of pre-fin. metal flashing with membrane reinforced flashing by this section.
7. At stepped flashings at high walls above low, turn up ends of flashing to maintain a positive water flow out of the cavity wall.
8. Blueskin TG to form flashing at base of all cavity walls at grade and Blueskin TWF over all formed pre-fin. metal flashings where membrane is not supported by structure. Lap all seams a min. 4" (100 mm) and secure entire surfaces with adhesive.
9. At low roof high wall flashing locations install a reinforced membrane flashing below the pre-fin. metal flashing as well as Blueskin TWF above. The lower reinforced membrane flashing is to tie down into roof membrane.

6. Shrinkage Control Joints

1. Work shall include shrinkage control joints in wall constructed entirely or partially of masonry units manufactured of concrete:
 1. At all locations indicated on drawings.
 2. Provide additional interior control joints at junction of walls and columns at maximum horizontal spacing not exceeding 20'-0" (6 mm) in runs of walls where no openings occur at all locations where control joints are not indicated. Obtain Architect's approval of additional control joints prior to proceeding. Carry joints from support of wall to top of wall at structure above.
2. Control joints shall be constructed as detailed and shall provide a complete vertical separation through the wall. Joints shall be a nominal 3/8" (10 mm) wide.
3. Form control joints for interior block masonry walls by placing a layer of building paper up the height of the wall separating block on one side from adjacent block or column. Fill void between

blocks with mortar. Rake joints back 3/8" (10 mm). Building paper shall not be exposed.

4. Form shrinkage control joints in exterior masonry walls by placing premoulded joint filler in continuous vertical joint, full height of wall. Leave pre-moulded filler back from face of wall to allow space for joint filler and sealant under Section 07900

7. Expansion Joints

1. Construct expansion joints in unit masonry walls as shown on drawings and specified.
2. Install premoulded expansion joints where called for on drawings.
3. Caulking to be done under Section 07900.

8. Joint Reinforcement

1. Reinforce all walls and partitions of concrete masonry units, solid and cavity, and single wythe block walls with joint reinforcement placed in horizontal joints at alternate courses 16" (400 mm) unless indicated otherwise. DO NOT extend joint reinforcement through control joints. Overlap all joints a minimum 8" (200 mm).
2. Where openings occur in these walls, place joint reinforcement in joints at every 8" (200 mm) course, within 32" (800 mm) above and below openings for a distance of 24" (600 mm) beyond opening.
3. Reinforce all masonry walls where thickness is reduced by a column or chase with a 48" (1200 mm) length of joint reinforcement placed in horizontal joints at 16" (400 mm) centres. Centre reinforcement on column or chase.
4. Install prefabricated corner sections in reinforced joints at corners and prefabricated tee sections at reinforced joints where partitions intersect other partitions or walls, unless lateral support is being provided or walls or partitions are erected on a different foundation.
5. Where intersecting walls are erected on different foundations and lateral support is not required, provide straight joint full height of wall with masonry ties at every second joint. Rake joint 3/8" (10 mm).
6. All exterior wall reinforcing to be stainless two wire ladder type with stainless steel Fero Block Shear Connector Tie with V-Tie leg. All interior partition wall reinforcing and anchors mill galvanizing ladder design

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7. Provide structural work as detailed on structural drawings.
 8. Place masonry reinforcement according to CSA-S304-94.
 9. Bonding
 1. Wythes of masonry walls shall be bonded by means specified and/or shown on drawings, or as otherwise required by authorities having jurisdiction.
 2. Use running bond unless otherwise indicated.
 3. Cavity wall wythes shall be bonded with joint reinforcement at 16" (400 mm) o.c. and staggered cross members of reinforcement at alternate courses.
 10. Built-in Work
 1. Set all loose and miscellaneous items of steel and iron, including all isolated beams, lintels, shelf angles, bearing plates, ventilators and all other loose iron and steel work specified for erection or setting by others when built into masonry work. These items shall be grouted in place using cement mortar.
 2. Install 30 pound (13600 g) building paper felt under steel lintel bearing on one side only. Locate this bond breaker on the same as the control joint occurs.
 3. Supply and install all vertical steel reinforcement and grouting indicated on the structural drawings. Grouting to be installed using at maximum 5'-0" lifts (1525 mm) using low lift grout.
 11. Closures, Bellows and Water Stops
 1. Provide preformed pre-fin. metal water stops and closures formed as indicated on drawings.
 2. Overlap all joints a min. 6" (150 mm) to obtain water flow to the exterior and apply 3 beads of sealant at joint.
 12. Bent Metal Closures
 1. Supply and install 12 gauge stainless steel preformed closures around all windows, curtain wall and door openings, expansion joints and where detailed at control joints near exterior corners as detailed on drawings.

13. Filled Block Partitions

1. Fill all cavities in block partition with concrete and/or grout where indicated.
2. Perimeter walls at Rooms 139 to 154 to be reinforced and filled solid full height.

2. POINTING AND CLEANING

1. Point using concave joint at all areas except at single scored block which shall be tooled to match square score in block and provide other joint finishes where directed by Architect.
2. Point all holes, except weepers in masonry. Cut out all defective joints and repoint them with mortar.
3. Clean exposed masonry to satisfaction of Architect after mortar has hardened.
4. Wire brushes or abrasives shall not be used for cleaning.
5. Use of muriatic acid shall not be used for cleaning.
6. Leave masonry clean and free of mortar daubs and with tight mortar joints. Submit data for Architect's approval of chemical cleaner to be used to remove excess mortar on masonry.
7. Rinse masonry surfaces with water immediately after cleaning.
8. Remove and replace defective material at Architect's direction and at no cost to the Owner.
9. Clean up masonry debris and remove from site.

END OF SECTION

PART ONE - GENERAL

1.1 DESCRIPTION

- 1.1.1 Furnish all labour, materials, equipment and services specified, indicated or required to supply, install and complete all structural steel and open web steel joists (OWSJ).

1.2 RELATED WORK DESCRIBED ELSEWHERE:

- .1 Section 03300 - Grouting under column bases and bearing plates
- .2 Section 05500 - Miscellaneous Metals

1.3 SUBMITTALS

- 1.3.1 Comply with the pertinent provisions of Section 01300.
- 1.3.2 Erection diagrams and shop drawings shall be consistent with the design drawings prepared by the Consultant. Submit copies of erection diagrams to the Consultant for review before preparation of shop drawings. Submit shop drawings to the Consultant for general review of arrangement of details and type of connections before commencing fabrication. Furnish copies of erection diagrams and shop drawings to the Consultant for distribution. The Consultant's review of these shop drawings will not relieve the Contractor of responsibility under the Contract.
- 1.3.3 Shop drawings shall show the size, spacing, and location of structural steel and joists and all connections, attachments, reinforcing and anchorage. Diagrams shall include all necessary plans, elevations and details. Identify each member by a standard mark, to be listed in the schedule shown on the fabricator's erection drawings and placed legibly on each unit at the time of fabrication.
- 1.3.4 Shop drawings shall show the seal and signature of a Professional Engineer, registered in the Province of Ontario, responsible for the design of the OWSJ and its ability to meet the design criteria shown on the drawings and/or OBC requirements. Maximum live load deflection for all open web steel joists is L/360 unless noted otherwise on the drawings. Camber joists for dead load.
- 1.3.5 Shop drawings of structural steel shall show the seal and signature of a Professional Engineer, registered in the province of Ontario, for design of connections.

1.4 DEBRIS

- 1.4.1 Promptly, as the work proceeds and on completion, clean up and remove from the site all rubbish, surplus materials and equipment.

1.5 STANDARDS

- 1.5.1 All Codes and Standards referred to herein are to be latest edition.

1.5.2 Applicable Codes and Standards governing the work of this Section:

- .1 CAN/CSA S16 - Limit States Design of Steel Structures.
- .2 CAN/CSA - G40.20 - General Requirements for Rolled or Welded Structural Quality Steel.
- .3 CAN/CSA - G40.21 - Structural Quality Steels.
- .4 CSA-W59 - Welded Steel Construction (Metal Arc Welding)
- .5 CSA-W47.1 - Certification of Companies for Fusion Welding of Steel Structures.
- .6 CSA - W48 Series Latest Editions - Welding Electrodes.
- .7 ASTM-A325M - High-Strength Bolts for Structural Steel Joints.
- .8 CAN/CGSB-1.40 - Primer, Structural Steel, Oil Alkyd Type
- .9 Current Ontario Building Code

1.6 CUTTING AND PATCHING

- 1.6.1 Make all necessary adjustments and cut and fit to suit adjacent work of other Sections. Make good all finishes after installation has been completed.

1.7 INSERTS AND OPENINGS

- 1.7.1 Supply anchor bolts, loose base plates and other items when required for setting by other Sections. Provide holes and openings required in the work of this Section for the work of the Sections.

1.8 DIMENSIONS AND FIELD MEASUREMENTS

- 1.8.1 Check all dimensions before commencing shop drawings, fabrication, and installation and report all discrepancies to the Consultant. Where dimensions are not available before work is commenced, the dimensions required shall be agreed upon between the various trades concerned and approved by the Consultant.
- 1.8.2 Before commencing operations, verify the location and obtain all necessary measurements of structures which might affect the work of this Section. Before commencing erection verify the location and elevation of all anchor bolts for columns and verify that the foundations or piers are at the proper elevation and ready to receive the base plates. Check any existing floor levels for the proper alignment of new floors.

1.9 WORKMANSHIP

- 1.9.1 The work of this Section shall be done in accordance with the best practice by skilled labour.

1.10 INSPECTION AND TESTING

- 1.10.1 An inspection and testing company may be appointed and paid by the Owner to inspect the work of this Section. Give full cooperation to the Inspectors and the Consultant in the making of inspections and tests at all places where work is being done or stock is piled. The Inspector will report to the Consultant the

progress of the work, the manner of procedure, the quality of the materials and workmanship and the compliance with the Contract Documents.

- 1.10.2 The Inspector will call to the attention of the Contractor or his representative any improper workmanship or defective materials and it is understood and agreed that the Inspector shall have authority to direct stoppage of any improper practices until the Consultant has investigated the matter and made his decision. The Inspector will give his instructions directly to the Contractor or his representative on the job; he is not authorized to give orders to any other employees of the Contractor. Inspectors are not authorized to change, enlarge or diminish the provision in the Contract Documents in any degree whatsoever.

PART TWO - PRODUCTS

2.1 MATERIALS

- 2.1.1 Structural steel shall be new material of the sizes and shapes indicated on the drawings and all W-shapes & S-shapes sections shall conform to ASTM A992 & ASTM A572 Grade 50 $F_y=345\text{MPa}$, all C-shapes sections & Angles shall conform to G40.21-350W $F_y=350\text{MPa}$, all HSS hollow structural sections shall conform to G40.21-350W Class C $F_y=350\text{MPa}$, all others (plates, rods) shall conform to G40.21-300W $F_y=300\text{MPa}$.
- 2.1.2 Welding materials shall comply with CSA W59.
- 2.1.3 High strength bolts, nuts and washers shall comply with ASTM A325M.
- 2.1.4 Bolt heads shall be identified on the top of the head by three radial lines, the legend "A325" and the manufacturer's mark.
- 2.1.5 Standard primer for shop paint and touch-up in the field shall comply with CISC/CPMA Standard 1-73a One-Coat Paint and CISC/CPMA Standard 2-75 Primer.

PART THREE - EXECUTION

3.1 FABRICATION

- 3.1.1 Use shop and field connections indicated on the structural drawings. In the absence of such indication, comply with current CAN/CSA S16.
- 3.1.2 Trim and cut top plates to shape by machine gas cutting or carefully guided manual gas cutting to avoid rough or damaged edges caused by shearing. Accurately cut beams and plates which are exposed in the finished work to avoid excessive widths of welds forming connections. Continuously weld and

weatherproof connections which will be exposed on the exterior of the building in the finished work. Grind all such welds to present true and straight lines.

- 3.1.3 Cut steel members in the field only when directed by the Consultant, who may direct that holes be suitably reinforced with welded steel plates.
- 3.1.4 At any time before the detailed drawings are completed and approved, if requested, provide punched holes up to 20mm diameter for the convenience of other trades in attaching wood or other materials to structural members. Place holes for connections, wood lagging or for other purposes so as not to cause any appreciable reduction in the strength of members. Provide holes for services and reinforce as indicated on the structural drawings.

3.2 DESIGN OF CONNECTIONS

- 3.2.1 If requested by the Consultant, or the local authority having jurisdiction over the work, submit structural calculations and such further proof as may be called for to show that the design, fabrication and erection of the work of this Section complies with the specifications, drawings, local by-laws and all relevant codes and standards.
- 3.2.2 Design the minimum connections for beams in accordance with CISC framed beam connection details based on 20mm high strength bolts to develop the stated reaction or the full uniform-load capacity for the given span or the **50%** of maximum full shear capacity of the member, whichever is greater. Use double angle connections where possible.

3.3 WELDING

- 3.3.1 Welding shall comply with CSA W59. Any fabricator undertaking to weld under this contract shall be fully approved by the Canadian Welding Bureau, under the requirements of CSA W47, Division 1 or 2.1.
- 3.3.2 Do not field weld during rain, snow or sleet. Drive off moisture from dew or fog by heat before welding commences. Provide windbreak protection to protect the work area from direct wind. Do not weld when the air temperature is below -18°C (0°F). If the air temperature is above -18°C (0°F), but is cold enough to prevent the welder from producing sound work then welding will not be permitted.
- 3.3.3 Prepare ends of beams, girders, and other members to be welded by gas cutting in the shop, taking into account the relative position of the member in the finished structure, and the grade, camber or curvature of the member.
- 3.3.4 Minimum pre-heat and interpass temperatures, within 75mm of the location of weld deposits, shall be in accordance with good welding practice. Form welds with sound clean metal completely fused to the base metal. Ensure complete penetration of the joint. Gouge out and re-weld all welds which show inclusions, porosity, lack of fusion, poor penetration or uneven contour, sagging or overlapping parent metal. Clean welds between passes and at completion and remove slag with a descaling tool and wire brush. Where welds show

undercutting run in a small stringer bead along the toe of the undercut using a smaller diameter electrode than that used for the original weld. Fill weld craters flush with weld metal. Check root passes for penetration and cracks from the back side of the joint. Gouge out any crack, regardless of size, 50mm beyond each end of the crack and reweld.

3.3.5 Before final acceptance of welding make a thorough check to ensure that all welds required have been made. Check all fillet welds with a gauge to determine that none are undersize or short in length.

3.3.6 Check welds for cleanliness before painting.

3.4 ERECTION

3.4.1 Make adequate provision for erection stresses and for temporary bracing to keep the structural steel frame plumb and in true alignment during construction of the building. Bracing members shown on the drawings are required for the finished structure and it is not to be assumed that they are adequate for construction purposes. It shall be the sole responsibility of the Contractor to make proper and adequate provisions for erection stresses and for temporary bracing.

3.4.2 Plumb and level individual pieces of the structural frames to a tolerance not exceeding 1 to 500, except that for exterior columns the tolerance shall not exceed 1 to 1000.

3.4.3 Straighten small bends and kinks received during transportation before members are erected. At the discretion of the Consultant replace all members seriously damaged. Provide any temporary beams required for erection purposes, and remove them when no longer required. Set column bases on steel shims or concrete screeds ready for grouting by the Concrete Section. Use wooden mallets for driving or hammering steel members into position. Do not use steel or iron sledges. Take every care to prevent the structural members from falling or being subjected to heavy shock or impact from other members being swung into position.

3.4.4 Report to the Consultant every failure of fabricated materials to fit together properly before taking any corrective measures.

3.4.5 Unless noted otherwise high-strength bolts shall be tightened in accordance with Turn-of-nut method specified in CAN/CSA S16 Design of Steel Structures.

3.5 SHOP PAINTING

3.5.1 Before commencing shop painting, clean all steel surfaces by wire brushing to remove loose mill scale, rust, oil, dirt, and other foreign matter. Clean welds prior to painting, by wire brushing and washing down with clean water, to remove the chemical residues left by the welding electrodes. Material to be painted shall be completely dry, shall be painted under cover and shall remain under cover until the paint is thoroughly dry. Apply shop paint only when the air and steel surface temperatures are above 5°C (40°F). Do not paint the following surfaces:

-
- .1 Steel to be encased in concrete or to receive **contact-type** fireproofing such as intumescent fireproofing or cementitious fireproofing.
 - .2 Surfaces and edges to be field welded. If painted, remove paint for field welding for a distance of at least 50mm on all side of the joint.
 - .3 The contact surfaces of connections assembled by high-tensile bolts within friction type joints.
- 3.5.2 Apply one coat of the specified prime paint by dipping, brushing or spraying.
- 3.5.3 Work paint into all joints and open spaces.
- 3.5.4 After erection spot paint with the specified prime paint, field bolt heads and nuts, field welds and any abrasions, rust or damage to the shop coat of paint.
- 3.5.5 All steel exposed to exterior environment shall be hot dipped galvanized in accordance with CSA G164. This will include interior lintels that are connected to steel exposed to the exterior environment (i.e. a combined lintel for brick and block).

END OF SECTION

PART ONE -GENERAL

1.1 SECTION INCLUDES

- 1.1.1 Structural steel roof deck.
- 1.1.2 Structural hi-bond floor deck.

1.2 RELATED SECTIONS

- .1 Section 03300 - Cast-In-Place Concrete: concrete topping over metal deck.
- .2 Section 05120 – Structural Steel.
- .3 Section 07500 - Membrane Roofing: installation of acoustic deck insulation.
- .4 Section 07250 - Applied Fireproofing: cementitious fireproofing.

1.3 REFERENCES

(All Codes and Standards referred to herein are to be latest edition.)

- .1 ASTM A446: Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
- .2 CAN/CSA-S136: Cold Formed Steel Structural Members.
- .3 CSA W47.1: Certification of Companies for Fusion Welding of Steel Structures.
- .4 CSA W55.3: Resistance Welding Qualification Code for Fabricators of Structural Members Used In Buildings.
- .5 CSA W59: Welded Steel Construction (Metal Arc Welding).
- .6 Canadian Institute of Steel Construction: Handbook of Steel Construction.
- .7 CSSBI 101: Specification for Zinc Coated Structural Quality Steel Sheet for Roof and Floor Deck.

1.4 SYSTEM DESCRIPTION

- 1.4.1 Design metal roof and hi-bond floor deck to CSA-S136.
- 1.4.2 Design deck units to span continuously over 3 spans, supplied in proper length for support conditions. Roof deck is designed as a diaphragm.
- 1.4.3 Maximum Live Load Deflection: 1/360th of span.

1.5 SUBMITTALS

- 1.5.1 Submit erection and detail shop drawings to requirements of Section 01310.
- 1.5.2 Indicate decking plan, support locations, projections, openings and reinforcement, outlet box locations, pertinent details and accessories.
- 1.5.3 Design deck layout, spans, fastening, joints, and openings under the direct supervision of a Professional Structural Engineer experienced in design of this work

and licensed in the Province of Ontario. Deck drawings shall be stamped by the Professional Engineer responsible for direct supervision.

1.6 QUALITY ASSURANCE

- 1.6.1 Welding: undertaken only by organizations fully approved by the Canadian Welding Bureau, meeting the requirements of CSA W47.1 and CSA W55.3.

1.7 DELIVERY, STORAGE AND HANDLING

- 1.7.1 Transport and store the fabricated metal deck at the Site in such a manner as to ensure the panels are not bent, warped or subject to corrosion.
- 1.7.2 Damaged material will be rejected.

PART TWO - PRODUCTS

2.1 MATERIALS

- 2.1.1 Steel Roof Deck, Type B Deck: 0.91mm (or 1.22mm, see drawings) thick, 38mm deep; fluted steel roof deck to ASTM A653M SS Grade 275 (Fy = 275 MPa) galvanized steel with a zinc coating of ZF75 Galvaneal, flutes spaced at 150mm centers c/w interlocking male and female side laps. Canam **P-3615 (1.5BI)** or approved equal.
- 2.1.2 Steel Floor Deck: 0.91mm (or 1.22mm, see drawings) thick, 38mm deep; fluted steel floor deck, composite floor type ASTM A653M SS Grade 275 (Fy = 275 MPa) galvanized steel with a zinc coating of ZF75 Galvaneal, flutes spaced at 152mm centers, with integral lugs on the web face of the flutes to achieve proper composite action. Canam **P-3615 composite (1.5BLI)** or approved equal.
- 2.1.4 Sound Attenuating Insulation: mineral fiber sound attenuating insulation strips, shaped to fill acoustic flutes; Owens-Corning AF110.
- 2.1.5 Cover Plates, Cell Closures and Flashings: steel sheet; 0.76mm thick; ZF75 zinc coating.
- 2.1.6 Closures to External Walls: neoprene or polyvinyl chloride, closed cell type.
- 2.1.7 Sealant: as specified under Section 07900.

PART THREE - EXECUTION

3.1 EXAMINATION

- 3.1.1 Verify that field conditions are acceptable and are ready to receive work.
- 3.1.2 Ensure openings in deck required by others have been designed for.
- 3.1.3 Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- 3.2.1 Erect metal decking to requirements of CSSBI standards.
- 3.2.2 Erect decking on support surfaces with 50mm minimum bearing. Align and level.
- 3.2.3 Fasten deck to steel support members at ends and intermediate supports with 19mm OD puddle welds at 300mm OC maximum, Marginal (perimeter) welds at 150mm OC maximum unless note otherwise, refer to deck fastening pattern schedule on drawings.
- 3.2.4 Mechanically clinch male/female side laps at 600mm OC maximum unless noted otherwise, refer to deck fastening pattern schedule on drawings.
- 3.2.5 Cut and structurally reinforce openings in the deck as shown and to requirements of the approved shop and erection drawings.
- 3.2.6 Structurally reinforce openings 300mm square or smaller, but larger than 150mm square or 150mm round. Openings smaller than outlined above need not be reinforced.
- 3.2.7 Do not allow additional openings in deck without prior written approval by Consultant.
- 3.2.8 Install 150mm minimum wide sheet steel cover plates, of same thickness or decking, where deck changes direction. Fusion weld at 300mm OC maximum.
- 3.2.9 Make connections and deck alignment neat and to the approval of the Consultant. Replace dented, damaged, or weld-perforated deck.
- 3.2.10 Install wet concrete stops at floor deck edge, upturned to top surface of slab. Provide stops of sufficient strength to remain stationary without distortion during concrete pours.
- 3.2.11 Install enclosures and angle flashings to close openings between deck and walls, columns and openings, as described below:
 - .1 Where fluted end of metal decking rests on exterior masonry walls, fill web spaces with closed cell neoprene or polyvinyl chloride closures as recommended by manufacturer.
 - .2 Where deck flutes are perpendicular to exterior walls, and decking exposed on underside extends beyond these walls, caulk interlocking side laps of decking for 400mm immediately over walls. Install interior and exterior closures. Caulk exterior closures to prevent air infiltration and interior closures to prevent water vapour exfiltration. Provide Section 07500 with sufficient

- quantity of closures to close off topside flutes directly over face of wall.
- .3 Where flutes run perpendicular to interior partitions, install double run of steel closures as recommended by manufacturer.
- .4 Where flutes are parallel to interior partitions, install steel closure flashings to provide neat juncture between two materials, as recommended by manufacturer.
- .5 Closures are not required between interior partitions and underside of decking in areas designated to receive suspended ceiling.
- 3.2.12 Provide sound attenuation strips to Section 07500 for installation in acoustic flutes.

3.3 FIELD QUALITY CONTROL

- 3.3.1 Field inspection and testing will be performed under Section 01410.
- 3.3.2 Inspect steel deck welds for structural integrity.

3.4 ADJUSTING

- 3.4.1 After erection and anchorage, grind smooth all welds and make good zinc coating wherever scratched, chipped or damaged.
- 3.4.2** Fill all holes blown through the deck during welding with weld metal.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

1.2.1 Tread and landing fill: Section 03300, Cast-In-Place Concrete.

1.2.2 Structural steel stairwell support members shown on structural Drawings: Section 05120, Structural Steel.

1.2.3 Finish painting: Section 09900, Painting and Finishing.

1.3 REFERENCES (Latest Editions)

ASTM A53/A53m	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A325	Specification for High-Strength Bolts for Structural Steel Joints [Metric]
ASTM A 653/A653M	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM A1011/A1011	Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy with Improved Formability (ASTM A570M withdrawn)
CAN/CGSB-1.40	Primer, Structural Steel, Oil Alkyd Type
CAN/CGSB-1.81	Air Drying and Baking Alkyd Primer for Vehicles and Equipment
CAN/CGSB 1.181	Coating, Zinc-Rich, Organic, Ready Mixed
CAN/CSA-G40.20/G40.21	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
CAN/CSA-G164	Hot Dip Galvanizing of Irregularly Shaped Articles
CAN/CSA-S16	Limit States Design of Steel Structures
CAN/CSA-S136	Cold Formed Steel Structural Members
CSA W59-M89	Welded Steel Construction (Metal Arc Welding)

1.4 SUBMITTALS

1.4.1 Submit shop drawings for metal stairs and railings, stamped by a Professional Engineer registered in the province of Ontario.

1.4.2 Indicate and describe in detail profiles, members, type and details of fastening and anchorage, thicknesses and metal finishing and all other pertinent data and information, such as the design loads for stairs and guards.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

1.5.1.1 Conform to requirements of following:

- CAN/CSA-S16
- CAN/CSA-S136

1.5.2 **Qualifications**

- 1.5.2.1 Work of this Section shall be executed by firm having previous experience in similar fabrications, thoroughly conversant with laws, by-laws, regulations which govern and capable of workmanship of best grade of modern shop and field practice.

2 **PRODUCTS**

2.1 **MATERIALS**

- 2.1.1 **Steel, Structural Quality, WWF, W-Shapes, HSS Sections and Structural Tees:** CAN/CSA-G40.20/G40.21-M, Grade 350W.

- 2.1.2 **Steel, Structural Quality, Plates, Angles and C-channels:** CAN/CSA-G40.20/G40.21-M, Grade 300W.

- 2.1.3 **Sheet Steel:** (Structural Quality) ASTM A570M.

- 2.1.4 **Bolts, Nuts and Washers:** ASTM A325M.

- 2.1.5 **Galvanizing:**

- 2.1.5.1 **Sheet Steel:** ASTM A 653/A653M

- 2.1.5.2 **Irregularly Shaped Articles:** CAN/CSA-G164-M.

- 2.1.5.3 **Tube:** ASTM A53/A53M.

- 2.1.6 **Welding Materials:** CSA W59-M.

- 2.1.7 **Preparation of Zinc Coated Steel Surface For Prime Painting:** CAN/CGSB-31.116-M.

- 2.1.8 **Primer:** Conform to following requirements:

- 2.1.8.1 CAN/CGSB-1.40-M.

- 2.1.8.2 CAN/CGSB-1.81-M.

- 2.1.8.3 CGSB 1-GP-181M.

- 2.1.9 **Handrail:** PVC, extruded to profile indicated, in colour selected by ORC Designee.

- 2.1.10 **Non-Shrink Grout:** premixed, non-shrink, non-metallic aggregate; compressive strength to suit application.

Acceptable Products

Sika Canada Inc.

Euclid Admixture Canada Inc.

W. R. Meadows of Canada Ltd

CPD Services

Sika Grout 212 Regular

Euco NS Grout

Non-Metallic Grout

Non-Shrink (premixed)

2.2 **FABRICATION**

2.2.1 **Design Requirements**

2.2.1.1 Fabricate stairs to safely support a live load of 490 kg/m² (100 lbs/sq ft) evenly distributed over treads and landings.

2.2.1.2 Fabricate railings to conform to the current Ontario Building Code.

2.2.2 **General**

2.2.2.1 Fabricate to the reviewed shop drawings and in general to details indicated on Drawings and specified herein.

2.2.2.2 Where possible, fit and shop assemble various sections of work and deliver to site in largest practicable sections.

2.2.2.3 Fabricated work shall be complete with components required for anchoring.

2.2.2.4 Fit joints and intersecting members accurately with hairline joints in the least conspicuous locations and manner. Make work in true plane with adequate fastenings.

2.2.3 **Welding**

2.2.3.1 Make stairs of completely welded construction CSA W59-M.

2.2.3.2 Grind exposed welds smooth and machine materials and straighten in such a way that no disfigurement will show in finished work.

2.2.4 **Fastenings and Connections**

2.2.4.1 Weld connections where possible; where not possible bolt or otherwise secure in an approved manner.

2.2.4.2 Where approved, install exposed fastenings, of same material, colour and finish as base metal on which they occur.

2.2.4.3 Countersink screws unless noted otherwise and reinforce where necessary.

2.2.4.4 Use shop and field connections detailed, where not detailed, connections, CAN/CSA-S16.

2.2.5 **Components**

2.2.5.1 **Exterior Steel Stairs**

- Stringers: Channel with welded-on steel cover plated.
- Landings: Channel supports, steel gratings, channel bearings, steel angle purlins and cleats.
- Treads: Steel gratings with checkered plate nosing.
- Balusters and Handrails: Steel bars.

- Columns: Hollow structural steel sections.
- Bracing: Steel bars.

2.2.5.2 Interior Steel Stairs

- Risers, Treads and Landings: Steel pan, 2.8 mm (12-gauge) steel core thickness.
- Provide steel dowels on landings and treads for pre-cast terrazzo treads or hooks for reinforcing for poured-in-place terrazzo.
- Form tread with metal nosing and key at risers for fill.
- Balusters and Handrails: Steel bars with vinyl handrail caps.

2.2.5.3 Soffits

- Weld angles in position to support furring channels for gypsum board soffits.

2.2.6 Prime Painting

- 2.2.6.1 After shop fabrication, thoroughly descale steelwork, remove roughness and irregularities by grinding, clean with wire brush, remove oil and grease from surface of steel and give one coat of primer. Give steelwork one coat of primer in shop working well into crevices and interstices.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Furnish, set and secure framing brackets, hangers, anchors, inserts or similar supports for proper erection of stairs before masonry and concrete is placed.
- 3.1.2 Provide temporary supports and bracing required to position stairs.
- 3.1.3 Do all cutting, drilling and fitting necessary to attach work of this Section to adjoining work.
- 3.1.4 Weld strings to structural steel trimmers and anchor end of bottom of stringers to floor slab.
- 3.1.5 Continuously weld connections between handrails and balusters and in lengths of handrails.
- 3.1.6 Secure wall brackets to walls with through bolts and plate where these can be concealed, otherwise use bolts and expansion shields to achieve maximum rigidity of rail. Wood plugs for fixing to walls will not be permitted. Use metal anchoring devices.
- 3.1.7 Use plaster rings where wall rail brackets occur on plaster surfaces.
- 3.1.8 Grout bases of posts, occurring in concrete into metal sleeves using grout in accordance with manufacturer's instructions. Finish smooth, level and flush with surrounding finished surface.
- 3.1.9 Insulate where necessary to prevent electrolysis due to dissimilar metal to metal

contact or metal to masonry and concrete. Use bituminous paint, butyl tape, building paper or other approved means.

- 3.1.10 Grind off surplus welding material and provide sharp profiles and arrases.
- 3.1.11 Install plastic handrail in accordance with manufacturer's recommendations. Make each run of handrail continuous and close exposed ends with plastic, welding and smoothing junctions to match adjacent surfaces with undetectable joints. Clean, wax and polish rail to high lustre.
- 3.1.12 Build and erect work plumb, true, square, straight, level, and accurate to sizes detailed, to reviewed shop drawings, free from distortion or defects detrimental to appearance and performance.
- 3.1.13 Prime base metal surfaces, field welds, damaged and abraded primed surfaces, and surfaces not previously primed and leave ready for finish painting by Section 09900, Painting and Finishing.

End of Section

1. **GENERAL**

1.1. Conform to Sections of Division 1 as applicable.

1.2. **RELATED SECTIONS**

1.2.1. Installation of Stainless Steel Transaction Tray for Millwork: Section 06 41 00 Finish Carpentry and Millwork.

1.2.2. Firestopping and smoke seals: Section 07 84 00, Penetration Firestopping.

1.2.3. Finish painting: Section 09 91 00, Painting and Finishing.

1.3. **REFERENCES**

ASTM A53/A53M-02-	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M-02	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M-02	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A269-02a	Standard Specification For Seamless and Welded Austenitic Stainless steel Tubing For General Service
ASTM A307-02	Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A325M-00	Specification for High-Strength Bolts for Structural Steel Joints [Metric]
ASTM A325-02	Specification for Structural Bolts, Steel, Heat-treated 120/105ksi Minimum Tensile Strength.
A1008/A1008M-02e1	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A1011/A1011M-02	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability
ASTM A 653/A653M-02a	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
CAN/CGSB-1.40-97	Anticorrosive Structural Steel Alkyd Primer
CAN/CGSB-1.81-M90	Air Drying and Baking Alkyd Primer for Vehicles and Equipment
CAN/CGSB-1.181-99	Ready Mixed Organic Zinc Rich Coating
CAN/CSA-G40.20/G40.21-98	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
CAN/CSA-G164-M92(R1998)	Hot Dip Galvanizing of Irregularly Shaped Articles
CAN/CSA-S16.01	Limit States Design of Steel Structures
CSA W47.01	Certification of Companies For Fusion Welding of Steel Structures

CSA W48.01	Filler Materials and Allied Materials for Metal Arc Welding
CSA W59-M1989(R2001)	Welded Steel Construction (Metal Arc Welding)
CAN/CSA-W117.2-01	Safety in Welding, Cutting and Allied Processes
SSPC	Steel Structures Painting Council, "Steel Structures Painting Manual Vol. 2"

1.4. SYSTEM DESCRIPTION

1.4.1. Design Requirements

1.4.1.1. Generally, Drawings give information on specific shape and dimensions required and in certain cases, load imposed. For items where load information is only indicated, provide steel supports and anchorage for general design indicated, sized to suit specified loads. Provide bracing as may be required to counter lateral loads and dynamic stresses where vibration of support equipment may occur.

1.4.1.2. Comply with OBC, for design of all stressed members.

1.5. SUBMITTALS

1.5.1. Shop Drawings:

1.5.1.1. Submit shop drawings in accordance with Section 01 33 00 Submittals.

1.5.1.2. Show and describe in detail work of this Section including large scale detail of members and materials, of connection and jointing details, and of anchorage devices, dimensions, gauges, thicknesses, description of materials, metal finishing, as well as other pertinent data and information.

1.5.1.3. Shop drawings indicating structural components for custom fabricated or pre-fabricated components shall bear professional stamp and signature of professional engineer licensed to design structures and registered in Province of Ontario.

1.5.2. Certification:

1.5.2.1. Submit certification from registered professional structural Engineer registered in province of Ontario, who shall affix his/her seal and signature to certificate, stating structure is capable of supporting its own weight and specified live loads.

1.6. QUALITY ASSURANCE

1.6.1. Welder Qualifications:

1.6.2. Execute welding by firm certified in accordance with CSA W47.1 Division 1 or 2.1.

1.6.3. Operators employed on Work shall be qualified per CSA W47.1 for work as specified herein.

2. **PRODUCTS**

2.1. **MATERIALS**

2.1.1. **Steel, Structural Quality, WWF, W-Shapes, HSS Sections and Structural Tees:** CAN/CSA-G40.20/G40.21, Grade 350W.

2.1.2. **Steel, Structural Quality, Plates, Angles and C-channels:** CAN/CSA-G40.20/G40.21, Grade 300W.

2.1.3. **Sheet Steel:** ASTM A 653/A653M,

2.1.4. **Sheet Steel:** Commercial Quality ASTM A1008, stretcher levelled or temper rolled.

2.1.5. **Galvanized Sheet Steel:** Galvanizing as specified ASTM A 653/A653M, structural and commercial quality sheets. Must be specially treated by phosphate conversion process if steel is to be exposed and finish painted.

2.1.6. **Steel Pipe:** ASTM A53/A53M (standard weight) (extra strong) (double extra strong), (black) (galvanized) finish.

2.1.7. **Welding Materials:** Conform to CSA W48.1-M and CSA W59-M.

2.1.8. **Fasteners (Concrete Anchors, Toggle Bolts, and Hammer Driver Bolts)** to ASTM A307, Star Expansion, Hilti (Canada) Ltd. or Ucan Fastening Products.

2.1.9. **Metal Filler:** Polyester based, White 'Lightning' by Marson Canada Inc. or Combo or First choice by Dura Chemicals Ltd.

2.1.10. Conform to following requirements: CAN/CGSB-1.40-M.

2.2. **PREFABRICATED OR CUSTOM FABRICATED ITEMS**

2.1.1. **Non-Skid Decking at Parapet:** 3 mm checker plate, galvanized sheet steel, galvanizing as specified ASTM A 653/A653M, structural and commercial quality sheets. Must be specially treated by phosphate conversion process if steel is to be exposed and finish painted

2.1.2. **Roof Access Ladder:**

2.1.2.1. Stringers: 65 mm x lengths as per drawings/site conditions x 10 mm thick, steel bars.

2.1.2.2. Steel Rungs: 20 mm diameter, welded to stringers at 300 mm on centre.

2.1.2.3. Brackets: sizes and shapes as indicated, weld to stringers at maximum 1800 mm on centre, complete with fixing anchors.

2.1.2.4. Galvanize finish for exterior, prime paint for interior.

2.1.2.5. Galvanize exterior ladders after fabrication

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- 2.1.3. **Corner Guards and U-Channels:** stainless steel, corner guards, K29-3" x 3" x 48" high. Custom fabricate U-Channels to accommodate wall thickness as required to locations shown on drawings, 3" x wall thickness x 3" x 48" high/
Acceptable Manufacturer: Standard Metal Architectural Hardware or equal.
- 2.1.4. **Armour Plate at Ballistic Rubber :** 10 mm Armour Plate, 2100 mm wide x 2800 mm high where indicated.
- 2.1.5. **Thresholds:**
- 2.1.5.1. Supply and install thresholds for exterior doors other than vestibule doors as indicated on the Drawings, refer to Hardware Schedule for type.
- 2.1.5.2. Notch thresholds as required to fit jamb profiles neatly.
- 2.1.5.3. Provide four, evenly spaced countersunk fixings per threshold. Set thresholds in two continuous 6 mm (1/4") diameter beads of sealant. Refer to Section 07900 Sealants.
- 2.1.9 **Bollards:** Schedule 40 galvanized pipe 8" diameter x 48" high.
- 2.1.10 **Stainless Steel Transaction Tray:** CRL Brushed Stainless Deluxe 18" wide x 14-1/8" deep x 2-3/8" high Brushed Stainless Drop-In Deal Tray by C.R. Laurence of Canada (at Reception Counter).
- 2.3. **FABRICATION**
- 2.3.1. Fit and assemble work in shop where possible. Execute work according to details and reviewed shop drawings. Where full shop assembly is not possible, make trial assembly in shop.
- 2.3.2. Do welding to CSA W59-M. File or grind welds smooth and flush where exposed to view and where specifically indicated on Drawings.
- 2.3.3. Fit joints and intersecting members accurately. Make work in true planes with adequate fastening.
- 2.3.4. Supply fastenings, anchors, accessories required for fabrication of work of this Section. Such items occurring on or in exterior wall or slab shall be hot dip galvanized.
- 2.3.5. Fastenings include without being limited to anchor bolts, machine bolts, toggle bolts, self drilling anchor, lag screws, expansion shields, sleeves, brackets, washers and nuts.
- 2.3.6. Provide bolts with all washers and nuts required for complete installation. Provide lock washers where vibrations may occur.
- 2.3.7. Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise indicated or specified.
- 2.3.8. Keep exposed fastenings to an absolute minimum evenly spaced and neatly laid out.

2.3.9. Make fastenings of permanent type unless otherwise indicated.

2.4. Shop Welding:

2.4.1. Execute welding to avoid damage or distortion to Work. Should there be, in opinion of Consultant or Inspection and Testing Company, doubt as to adequacy of welds, they shall be tested for efficiency and any work not meeting Standards shall be removed and replaced with new work satisfactory to Consultant. Carry out welding in accordance with following Standards:

CSA W48-M: for electrodes (If rods are used, only coated rods are allowed)

CSA W59-M: for design of connections and workmanship

CAN/CSA-W117.2-M: for safety

2.4.2. Clean welded joints and steel exposed for sufficient space to properly perform welding operation. Neatly finish welds. Welds which will be exposed to view and finish painted shall be continuous and ground smooth.

2.5. Shop Painting:

2.5.1. Do not prime non-ferrous metals.

2.5.2. After fabrication, blast clean ferrous metals exposed in finished work, SSPC SP6. (Clean, brush, scrape and remove oil, grease and extraneous matter from other surfaces, solvent clean to SSPC SP1).

2.5.3. After cleaning mask edges with duct tape to be field welded.

2.5.4. Prime Finish: After cleaning, except where specified otherwise, apply full, smooth priming coat in shop. Work paint into corners and open spaces and deliver to Site with primer undamaged and to satisfaction of Consultant. (Commercial blast cleaned surfaces are to be primed immediately).

2.6. Hot Dip Galvanizing:

2.6.1. After fabrication, hot dip galvanize specific miscellaneous steel items indicated on Drawings and/or called for herein.

2.6.2. Straighten shapes and assemblies true to line and plane after galvanizing.

2.6.3. Repair damaged galvanized surfaces with brush or spray-applied anti-corrosion coating containing 92-95% zinc, in accordance with manufacturer's printed directions.

2.6.4. Galvanize following: Members exposed to elements when in final location; members embedded on exterior side of exterior walls; members imbedded in concrete; members specified in this Section or indicated on Drawings.

2.6.5. Hot-dip galvanize steel members specified to be galvanized except galvanized sheet steel, in accordance with CAN/CSA-G164-M and requirements of following ASTM Standards, with minimum coating weights or thicknesses as specified.

- 2.6.6. Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123; average weight of zinc coating per m² (sq ft) of actual surface, less than 6 mm (1/4") thickness members, 605 g (2 oz); 6 mm (1/4") or heavier thickness members, 710 g (2.3 oz).
- 2.6.7. Iron and Steel Hardware: ASTM A153; minimum weight of zinc coating, in (ounces per sq ft) of surface shall be in accordance with Table 1 of ASTM A153, for various classes of materials used on Work.
- 2.6.8. Galvanized steel sheet to ASTM A 653/A653M Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, coating designation Z275 (G90), minimized spangle and chemically treated. Weight of zinc coating, 275 g/m² (1-1/4 oz per sq ft) on both sides of sheet.

3. **EXECUTION**

3.1. **INSTALLATION**

- 3.1.1. Build and erect work plumb, true, square, straight, level and accurate to sizes detailed, to reviewed shop drawings, free from distortion or defects detrimental to appearance and performance.
- 3.1.2. Insulate metals where necessary to prevent corrosion due to contact between dissimilar metals and between metals and masonry, concrete or plaster. Use bituminous paint, butyl tape, building paper or other approved means.
- 3.1.3. Supply instructions, templates, and, if necessary, supervise installation of fastenings or accessories requiring to be built-in by other Sections of Work.
- 3.1.4. After erection and installation, clean work and apply field touch of same formula as shop coat primer to damaged or unpainted surface of shop primed material. Work primer into joints, crevices, interstices and open spaces.
- 3.1.5. Weld as specified herein.

3.2. **CONNECTIONS**

- 3.2.1. Main member connections shall be welded or bolted with high tensile strength bolts and double angle connections as listed in CISC Code of Standard Practice for Structural Steel.
- 3.2.2. **Bolted Connections**
- 3.2.3. High strength bolted connections shall be bearing type using M20 (3/4") bolts conforming to ASTM A325M. Secondary members may be bolted with machine bolts.
- 3.2.4. Perform high tensile bolted connections in accordance with CAN/CSA-S16.1-M and be field tested.
- 3.2.5. Accurately space holes of size 1.6 mm (1/16") larger than nominal diameter of bolt. High tensile bolt connections shall be bearing (friction) type unless noted otherwise.

3.2.6. Provide compressor or electrical equipment capable of supplying and maintaining required pressure at wrench.

3.2.7. Make connections without use of erection bolts, some high tensile bolts will serve that purpose.

3.2.8. Nuts or bolts, except high tensile bolts, shall be prevented from becoming loose by burring bolt thread, by welding or by lock washers or lock nuts.

3.3. Fasteners

3.3.1. Supply fasteners, anchors and accessories required for erection of work of this Section. Ensure items occurring on or in exterior wall or slab are hot dipped galvanized.

3.3.2. In concrete and masonry, use epoxy injection anchor for vibration and heavy loads, and where anchors may be close to edge or close to adjacent anchors.

3.3.3. Use sleeve anchors in hollow block and brick for light static loads.

3.3.4. Use ULC approved drop-in anchors for pipe and sprinkler systems suspended from concrete ceiling.

3.3.5. Use wedge anchors for light to medium static loads in concrete.

3.3.6. Use concrete screws for light static loads in concrete, block and masonry.

3.3.7. Use heavy load expansion anchors for heavy static, vibratory or impact loading in concrete.

3.4. Welding

3.4.1. Welds on exterior work shall be continuous to provide proper weathering.

3.4.2. Take necessary safety precautions in accordance with CSA Standards when we

3.4.3. lding is carried out in cold weather.

3.4.4. No welding of galvanized products is allowed.

3.5. SCHEDULES

3.5.1. **General:** Provide miscellaneous metal work indicated on Drawings and not included in work of other Sections in addition to items listed below.

3.5.2. Where items are required to be built into masonry, concrete or other work provide such items to respective Sections with all anchors and accessories for building in.

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- 3.5.3. **Itemized List:** Provide following metal work unless specifically designated to be supplied only. List supplied herein is not necessarily complete and shall be augmented by thorough inspection of Drawings and all other requirements to complete Work. Each item shall be as indicated on Drawings and as detailed on reviewed shop drawings:
- 3.5.4. **Lateral Supports for Masonry Partitions:** Steel angles 100 mm x 100 mm x 150 mm long (4" x 4" x 6") to underside of structure to provide lateral support for masonry partitions where they are carried up to underside of structures above finished ceilings and are not braced laterally by wedge and grout.
- Place angle each side of partition and secure to structure above at 1800 mm (6'-0") oc.
- 3.5.5. **Bollards:** Fabricate bollards of Schedule 40 galvanized pipe of sizes indicated with exposed ends ground smooth, sharp edges rounded off.
- Coordinate with Section 03 30 00, Cast-In-Place Concrete in setting in place.
- 3.5.6. **Interior Ladder:** Construct access ladders to details indicated by welding rod rungs to bar stringers.
- Steel components of exterior ladder to be hot dip galvanized after fabrication.
 - Submit shop drawings by Engineer for review by Consultant.
- 3.5.7. **Support Framing Systems:** Provide fabricated steel support for roof mounted safety anchors, moprack support, bench supports, and other framing systems indicated, complete with anchors, brackets, sleeves, screws and incidentals required to complete installations.
- Secure to wall and/or floor in semi concealed manner to support vanities greater than 2 m (6') in length or where end of vanity is not supported by abutting wall.
- 3.5.8. **Hangers for Light Enclosures:** Supply metal light hanger supports to Section 06 41 00, Finish Carpentry and Millwork for installation.
- 3.5.9. Provide steel sections which are:
- Not indicated and identified on Structural Drawings, unless noted to be supplied by another Section of Specifications.
OR
- Not noted on Drawings to be supplied by another Section of Specifications.
OR
- Not specified under another Section of Specifications.
- 3.5.10. Provide such items complete with anchors, brackets, bearing plates and other accessories required for installation.
- 3.5.11. Where steel sections are required to be built into masonry or concrete, supply such members to respective trades for building in.

3.5.12. Work shall include, without being limited to:

Steel lintels (loose), including those required over masonry openings and recesses for mechanical or electrical services.

Where lintels cannot be supported on masonry, provide plates anchored flush into column or wall and weld lintel thereto to satisfaction of Consultant.

Roof Framing; steel plates, sheet steel backing plates, metal supports for parapet flashing, angles and channels to provide framing at cants, curbs and parapets, galvanized after fabrication.

Miscellaneous Items: Provide items complete with anchors, brackets, sleeves, screws and other incidentals required and as detailed.

- Where steel items or supports are required to be built into masonry or concrete, supply such members to respective trades.

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

1.2.1 Supply of wood doors: Section 08 14 00, Wood Doors.

1.2.2 Filling over surface nail holes: Section 09 91 00, Painting and Finishing.

1.2.3 Finish lumber for Fencing: Section 06 41 00 Finish Carpentry and Millwork.

1.3 REFERENCES

ASTM E84-18	Standard Test Method for Surface Burning Characteristics of Building Materials
CAN/CSA O80 Series-15	Wood Preservation
CAN/CSA O86-14	Engineering Design in Wood
CSA O121-17	Douglas Fir Plywood
CSA O151-17	Canadian Softwood Plywood
CAN/ULC-S102-10	Surface Burning Characteristics of Building Materials and Assemblies
NLGA	National Lumber Grades Authority, Standard Grading Rules for Canadian Lumber, 1987
ULC	Underwriters' Laboratories of Canada

1.4 SHOP DRAWINGS

1.4.1 Submit shop drawings in accordance with Section 01 33 00 Submittals.

1.4.2 Shop drawings shall clearly indicate material being supplied and shall show all connections, attachments, reinforcing, anchorage and location of exposed fastenings.

2 PRODUCTS

2.1 MATERIALS

2.1.1 **Framing Lumber:** Lumber for each type of structural component shall be of same species and grade, equally seasoned and shall be processed and stamped at same mill. Lumber identification shall conform to requirements of Standard Grading Rules for Canadian Lumber of National Lumber Grades Authority (NLGA).

2.1.2 **Grading:** 120, National Grading Rule for Dimension Lumber.

2.1.3 **Studs:** Spruce, 122b "Construction" light framing.

2.1.4 **Joists and Other Framing Members:** Spruce 124b. "No. 1" Structural Joists and Planks, except as otherwise specified.

- 2.1.5 **Members Other Than Studs and Less Than 89 mm (4") Wide:** Spruce, 122c. "Standard" light framing, except as otherwise specified.
- 2.1.6 **Nailing Strips, Blocking, Furring and Strapping:** Spruce, 122c. "Standard" light framing.
- 2.1.7 **Softwood Plywood, Douglas Fir, CSA O121-M of Following Grades:**
 - 2.1.7.1 Good One Side (G1S).
- 2.1.8 Canadian Softwood Plywood: CSA O151 of following grades:
- 2.1.9 **Wood Preservative**
 - 2.1.9.1 For painted surfaces use Pentox (clear) by Osmose-Pentox Inc. or Super Solignum-10-10 Paintable Penta by Solignum Inc.
 - 2.1.9.2 For concealed surfaces use Pentox (green) by Osmose-Pentox Inc. or Preserv-Green 1-42 by Solignum Inc.
- 2.1.10 **Rough Hardware:** Nails, screws, bolts, lag screws, anchors, special fastening devices and supports required for erection of carpentry components. Use galvanized components if exposed to exterior atmosphere. Galvanize in accordance with requirements of CAN/CSA-G164-M.
- 2.1.11 **Fire Retardant Treated Plywood (FRTD):** conform to CAN/CSA-O80 Series, ULC rated, for interior use.

3 **EXECUTION**

3.1 **INSTALLATION**

- 3.1.1 Construct and install work as indicated on Drawings.
- 3.1.2 Machine dressed work shall be slow fed using sharp cutters and finished members shall be free from drag, feathers, slivers or roughness of any kind.
- 3.1.3 Frame materials with tight joints rigidly held in place.
- 3.1.4 Design construction methods for expansion and contraction of materials.
- 3.1.5 Erect work plumb, level, square and to required lines.
- 3.1.6 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by work of other trades.
- 3.1.7 Fasten wood nailers, blocking, framing and strapping solidly to adjacent materials in true planes.

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- 3.1.8 **Furring, Bearing Plates and Rough Framing:** Provide and install where indicated on Drawings or required.
- 3.1.9 **Strips and Blocking**
- 3.1.9.1 Where wood is to be fastened to masonry, supply metal nailing plugs to Section 04 20 00, Masonry for building into masonry joints.
- 3.1.9.2 Provide and install wood strips and backing required for attaching work of other Sections.
- 3.1.9.3 Provide and install all wood blocking required.
- 3.1.10 **Wood Preservative Treatment**
- 3.1.10.1 Treat all surfaces of exterior blocking, curbs, cants and other concealed exterior woodwork, with wood preservative; apply in accordance with manufacturer's directions.
- 3.1.11 **Rough Hardware**
- 3.1.11.1 Supply and install all rough hardware.
- 3.1.11.2 Fasten to hollow units with toggle bolts and to solid masonry or concrete with lead expansion shields and lag screws. No organic fibre or wood plugs shall be used.
- 3.1.12 **Miscellaneous Carpentry Work:** Supply and install all other carpentry indicated on Drawings or as required for completion of work. Co-operate with other trades in installing items supplied by other Sections, cut openings in woodwork when so required and make good disturbed surfaces.
- 3.1.13 **Fire Retardant Treated Plywood:** Supply and install FRTTP indicated on Drawings and fasten to substrate using suitable fasteners.

End of Section

1 **GENERAL**

1.1 Conform to Sections of Division 1 as applicable.

1.2 **RELATED SECTIONS**

1.2.1 Supply of Stainless Steel Transaction Tray: Section 05 50 00 Miscellaneous Metals.

1.2.2 Supply of Aluminum Framing for Reception Counter: Section 08 41 00 Aluminum Framing.

1.2.3 Supply of Glazing: Section 08 80 00, Glazing

1.2.4 Supply of Abloy Locking hardware: Section 08 71 00, Finish Hardware.

1.2.5 Supply of quartz countertops and bench tops: Section 12 36 61 Quartz Countertops

1.2.6 Supply of Upholstered Seat for Bench: Section 12 64 00 Upholstered Bench.

1.3 **REFERENCES**

AWMAC	Architectural Woodwork Manufacturer's Association of Canada, Quality Standards for Architectural Woodwork, 1998
CAN/CGSB-12.1-M90	Tempered or Laminated Safety Glass
CAN2-12.3-M91	Flat, Clear Float Glass
CAN3-A172-M79(R1996)	High Pressure Paper Base, Decorative Laminates
CAN/CSA-G40.20/G40.21-98	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
CSA O115-M82(R2001)	Hardwood and Decorative Plywood
CSA O121-M78	Douglas Fir Plywood
CAN3-O188.1-M78	Interior Mat-Formed Wood Particleboard
NEMA	LQI, Decorative Board

1.4 **SUBMITTALS**

1.4.1 **Shop Drawings:** Submit shop drawings in accordance with 01 33 00 Submittals.

1.4.2 **Samples:** Submit samples of plastic laminate and finished wood to Consultant for approval as required in accordance with 01 33 00 Submittals.

1.4.3 **Samples required for all exposed Hardware.**

1.5 **QUALITY ASSURANCE**

1.5.1 **Qualifications:** Work of this Section shall be done by manufacturer and tradesmen with experience in successful manufacture and installation of this type of work and of quality as indicated on Drawings and as specified. Submit proof

of such experience with list of installations in Canada upon Consultant's request.

1.5.2 **Standards:** Work shall conform to Premium Grade requirements of AWMAC, Quality Standards For Architectural Woodwork.

1.5.3 **Site Quality Control:** Provide full-time, factory trained architectural woodwork supervisor to be present at Site at all times during execution of work specified in this Section.

1.6 **DELIVERY, STORAGE AND HANDLING**

1.6.1 Handle all materials and components carefully to prevent damage.

1.6.2 Do not deliver components to Site until work of wet trades is complete and moisture readings of surfaces in area of work is acceptable.

1.6.3 Protect components from moisture.

1.7 **PROJECT CONDITIONS**

1.7.1 Do all cutting and fitting and prepare components to receive and accommodate work of other sections.

1.8 **WARRANTY**

1.8.1 Warrant work of this Section against defects and deficiencies in accordance with CCDC-2 Requirements for a period of two (2) years. Promptly make good defects and deficiencies which become apparent within warranty period to satisfaction of Consultant and at no expense to Owner. Defects and deficiencies include but are not limited to delamination of plastic laminate work and warpage of millwork, cabinet hardware and adjustments to cabinet doors

2 **PRODUCTS**

2.1 **Wood**

2.1.1 Hardwood Trim (where indicated on drawings): solid maple trim where indicated on drawings, sizes as indicated to be finished.

2.1.2 Framing Lumber:

- Floors, Ribs, Sides and Back: Douglas Fir plywood, CSA 0121-M, regular grade, unsanded, thickness as indicated on Drawings.
- Nailing Strips, Blocking, Furring and Strapping: Spruce, Premium Grade.
- Joists and Other Framing Members: Spruce, Premium Grade.

2.1.3 Finish Lumber: Fencing, white cedar plank, No. 1 grade, no knots.

2.2 **Hardware**

2.2.1 Provide cabinet door hinges, door and drawer pulls, ball bearing drawer extensions, cylinder locks and keys for drawers, gate door hinges and latches,

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- pilaster strips and shelf clips, table glides and any other hardware required to complete work.
- 2.2.2 Cabinet/Drawer Pulls: 4484, 4" centers, Projection 1-5/16", solid aluminum in US28 by Stanley Hardware or equal. Provide one drawer Pull for each drawer and cabinet door.
- 2.2.3 Piano hinge: length to full length of door, nickel finish by Richelieu Hardware or equal. Refer to drawings for location and size.
- 2.2.4 Grommets (Cable Entry Plug) - Black 1-1/2" diameter, by Richelieu or equal, provide 4 - 6 grommets per counter at Room 111, 122, 143. Location of grommets to be determined on site. Refer to drawings.
- 2.2.5 Cabinet Hinges: Hetal, MB-8300 or 8500 Series for 19 mm cabinet sides, type best suited for location and intended purpose as distributed by Richelieu Hardware Ltd., (905) 672-1500
- 2.2.6 Box Drawer Slide: Model No. 3832 Easy-Close, full extension, side mount slide as manufactured by Accuride or equal.
- 2.2.7 Pull-Out Shelf Slide (Room 146): Model 322 as manufactured by Accuride or equal.
- 2.2.8 Steel Pilaster shelf standards and Supports: No. 255 Pilaster Standard with 256 ZC Steel shelf supports, surface mounted by Knappe & Vogt Canada Inc., or equal. House all intersecting gables, sides, bottoms and fixed shelves. Set adjustable shelves on clips on metal pilaster strips housed into gables and sides. Offset pilaster strips where they occur on both sides of a gable.
- 2.2.9 Disc Tumbler Cam Lock: recessed fitting, left/right/vertical hand, nickel plated steel finish, 7 disc size, cabinets and drawers where indicated) as manufactured by Abloy. Type selected to approval of West Grey Police Service. All cabinet door and drawer locks to be supplied by Hardware supplier and installed under this Section.
- 2.2.10 Abloy Cam locks for Millwork Lockers provided under Millwork Section: Installed under this section. Refer to Drawings for quantities.
- 2.2.11 Padlock and Padlock Hasp: PL330/25 Padlock and PL204, non-handed locking plate with 12 mm shackle hole as manufactured by Abloy. Padlock supplied by West Grey Police Service. Padlock hasp to be supplied and installed under this Section.
- 2.2.12 Lamacoid Plates for Locker numbers: 12 mm high x 25 mm wide, colour: black numbering to be approved by Client. Refer to Drawings for quantities.
- 2.1.1. **Coat Rod at Closet locations:** Provide 1" Closet Rod and 1" Flange (2 per rod). Provide intermediate rod support at centre point to support coat rod. R-80 and R83, bright stainless steel finish as manufactured by Standard Metal Hardware Manufacturing Ltd. or equal. at all closet locations.
- .1 Anti-Theft Hanger & Rings to be provided for a total of 20 hangers to be divided between the closets. Hangers to be high quality wood material with

clear finish.

2.2.13 High Pressure, Paper Base, Decorative Laminates: CAN3-A172-M.

Grades:

General Purpose Grades (GP)

Postforming Grades (PF)

Self Supporting Grades (SS)

Backing Grades (BK)

Types:

Heavy Duty Type (HD)

Standard Type (S)

Light Duty Type (LD)

Uses:

Used on flat horizontal and vertical surfaces. Durable, resist stains and temperature up to 130 deg C (266 deg F).

Similar to GP but can be formed.

Laminates of balanced construction with 1 or 2 decorative faces. Used in horizontal or vertical applications without supporting core.

Used to balance sandwich construction.

Uses:

For high abrasion and impact resistance horizontal applications e.g. reception counters. Available in 1.5 mm, 2.00 mm and 3.00 mm (0.059", 0.079" and 0.118") thicknesses.

For reasonable high resistance to damage on horizontal applications, e.g. kitchen working surface,. Available in 1.00 mm and 1.25 mm (0.039" and 0.049") thicknesses.

For moderate resistance to damage on horizontal and vertical applications. Available in 0.50 mm and 0.75 mm (0.020" and 0.030") thicknesses.

Grades and Types above are combined to describe individual materials.

E.g. General Purpose - Heavy Duty: GP-HD

Postforming - Light Duty: PF-LD.

2.2.13.1 Countertops Having Rolled Edge: PF-S, 1.25 mm (0.050") thick.

2.2.13.2 Countertops Having Square Edge, Bottom Interior Face of Cabinets: GP-S, 1.25 mm (0.50") thick.

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- 2.2.13.3 Vertical Surfaces of Doors and Drawers, Shelves: GP-S, 1.00 mm (0.40") thick.
- 2.2.13.4 Other Plastic Laminate Exposed Surfaces: GP-S, 1.00 mm (0.40") thick.
- 2.2.13.5 Millwork Laminate: Equal to: 8235K-95 Daintree, Timbergrain finish, Aeon Scratch Resistance or approved equal. Provide six (6) physical samples for Architect selection prior to ordering material.
- 2.2.13.6 Countertop laminate F: Equal to: Wilsonart 1595-60 Black (for fingerprinting room counter)
- 2.2.13.7 Interior laminate: Wilsonart 1595-60 Black (for fingerprinting room counter)
- 2.2.13.8 Backing Sheet: All panels shall be balanced with minimum 0.5 mm (0.020") backing sheet manufactured by same manufacturer as facing sheet.
- 2.2.13.9 Core: Plywood to CSA O115-M (G/SO) or CSA O121-M Grade "B" or Core material must be low VOC, low formaldehyde particleboard, Skyblend as manufactured by Roseburg Forest Products, Novopan Industrial-Grade particleboard or equal. Particleboard for use with laminated plastic, fine, smooth faces, to CAN3-0188.1-M78 Particleboard to CAN3-O188.1-M, Grade R.
- 2.2.13.10 Melamine: (at cabinet interiors) CAN3-0.188.1-M78, grade "R" particle board sanded faces, 13 mm, 16 mm, 19 mm, 28.6 mm and 32 mm thickness, faced with laminated plastic. Melamine resin impregnated cover sheet with coloured and/or patterned paper inner layer. Melamine shall be thermally fused to rigid particle board substrate. Melamine faces shall be 120 Gram Weight Paper. Maximum three colours/patterns to be chosen by Consultant from manufacturer's full range
- 2.2.14 **PVC Edging:** 3 mm (1/8") thickness, Dura-Edge edge banding to match laminate.
- 2.2.15 **Stainless Steel countertops and backsplashes:** 20 ga. Type 304 finish, mounted on 20 mm (3/4") plywood. Stainless Steel Backsplash where noted shall have exposed edges trimmed with stainless steel. Caulk all edges.
- 2.2.16 **Steel Angles:** CAN/CSA-G40.20-M and CAN/CSA-G40.21-M, sizes as indicated.
- 2.2.17 **Tempered Glass:** CAN2-12.3-M, Minimum 6 mm (3/8") thick. Glass to be provided and installed by Millwork contractor. Refer to drawings for size, grind and ariss edges smooth and silicone to cabinetry.
- 2.2.18 **Laminated Safety Glass:** CAN/CGSB-12.1-M, laminated layers of tempered glass, thickness as indicated on Drawings or as specified herein, minimum 10 mm total thickness. Thickness of glass provided by Millwork contractor for fingerprinting surface shall be level with adjacent surfaces.

- 2.2.19 Plastic glazing: Plexiglass or Acrylic Sheet, CAN/CGSB-12.12, clear colour, 3 mm or 12 mm thick as noted on drawings.

2.3 **FABRICATION**

- 2.3.1 **General Workmanship:** Fabricate work in accordance with AWMAC Quality Standards. Fabricate and install work in accordance with the best practice by skilled craftsmen of companies specializing in the work specified and to the requirements of other trades. Each item shall be as shown on Drawings and as detailed on Shop Drawings.
- 2.3.2 Lay out work carefully and to accommodate work of other trades. Accurately cut and fit. Join work only over solid backing.
- 2.3.3 Dress all exposed surfaces of casework and finished carpentry members.
- 2.3.4 Make running members in longest lengths obtainable.
- 2.3.5 Properly frame members with tight joints. Use glue blocks where necessary.
- 2.3.6 As far as practicable shop assemble work in size easily handled and to ensure passage through building openings. Deliver to site ready for installation. Leave adequate allowance for fitting and scribing on site.
- 2.3.7 Conceal joints and connections where ever possible. Locate prominent joints where directed by Architect. Intermediate joints between supports will not be permitted. Hidden spline joinery at all visible joint locations. Construct joints made on site for equal quality and workmanship as joints made in shop.
- 2.3.8 Unless otherwise specified, glue work and blind screw or nail. Set nail heads occurring in exposed work. Countersink all screw and bolt heads below finished surfaces. Do not drive screws and bolts. Fill all fastening depressions in exposed work with wood filler.
- 2.3.9 Accurately scribe, cope and mitre members where required.
- 2.3.10 Ensure that finished woodwork is free from bruises, mineral marks, knots, shakes and other defects. Select materials to ensure acceptance for colour, grain and texture.
- 2.3.11 Provide a sandpaper fine finish to remove machine marks, scratches and other marks from exposed or partially exposed wood surfaces. Finish to an even, smooth surface and leave work ready for an applied finish.
- 2.3.12 Provide 9.5 mm (3/8") thick solid, matching hardwood strip by thickness of plywood, less face veneers, on all plywood edges, exposed in the final assembly. Ensure face veneers completely overlap wood strips. Secure strips to edges with bonding adhesive. No exposed fasteners permitted. Apply strips

to edges of adjustable shelves.

- 2.3.13 Drawers: full box plywood construction. Front shall be 19 mm (3/4") thick; sides and back shall be 12.7 mm (1/2") thick. Fit sides to front and back with dovetailed joints. Provide 6.4 mm (1/4") thick plywood bottom, grooved into sides and front and nailed to underside of drawer back. Install box drawer slides to manufacturer's instructions

2.3.14 **Finishes**

- 2.3.14.1 Finish woodwork in factory.

- 2.3.14.2 Sand smooth woodwork and clean surfaces free of dust before applying first coat. Carefully sand with even strokes to provide perfect, scratch-free surface.

- 2.3.14.3 Sand lightly between finishing coats and remove dust.

- 2.3.14.4 Finish woodwork as described herein before installation at site.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Construct and install Work as shown on Drawings. Take measurements at site for finish carpentry work and casework to be built-in or attached to building structure, before commencing work of this Section.

- 3.1.2 Erect work plumb, level, square and to required lines.

- 3.1.3 Adjust drawers to operate without binding and to remain in closed position. Adjust hardware to function smoothly and without binding.

- 3.1.4 Scribe and fit counters into masonry joints as indicated.

- 3.1.5 Install glass where indicated on drawings.

- 3.1.6 Clean surfaces and refinish where damaged to match adjacent surfaces precisely. Replace badly damaged components.

3.2 Casework

- 3.2.1 Unless otherwise indicated or specified, fabricate casework units using the following materials and sizes. Factory assemble units carefully machined with dovetail, mortise and tenon, and stop dado joints. Securely glue joints with bonding adhesive.

.1 Frame for floor mounted units: plastic laminate

.2 Countertops: Fabricate countertops of both post-formed and hardwood edge construction as indicated.

.3 Sides, gables, tops, bottoms, shelves, backs: as indicated

- .4 House intersecting gables, sides, bottoms and fixed shelves. Set adjustable shelves on clips on metal pilaster strips housed into gables and sides. Offset pilaster strips where they occur on both sides of a gable.
 - .5 Doors: as indicated on drawings
 - .6 Drawers: Centre brace drawers greater than 30" long. Front shall be 3/4" (19 mm) thick; sides and back shall be 12.7 mm (1/2") thick. Fit sides to front and back with dovetailed joints. Provide 6.4 mm (1/4") thick plywood bottom, grooved into sides and front and nailed to underside of drawer back.
- 3.2.2 Unless otherwise indicated, block up bottom of floor mounted units to form a 100 mm high x 75 mm (4" x 3") deep toe space.
- 3.2.3 Where indicated, provide laminated plastic finish.
- 3.2.4 Where indicated, provide splashbacks and unless otherwise noted, make splashbacks 100 mm (4") high. Return splashbacks on side walls.
- 3.2.5 Shop install casework hardware for doors, including shelves and drawers.
- 3.2.6 Provide fillers of same material as casework, where necessary to fill voids between casework and between casework and walls or ceilings.

3.3 ALUMINUM SCREENS

3.3.1 Aluminum Screens

- 3.3.1.1 Set screens plumb, square, level, maintaining widths and heights.
- 3.3.1.2 Brace screens rigidly in position while building in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame, rebate height to maintain frame width. Provide vertical support at centre of head for openings exceeding 1200 mm (48") in width. Remove wood spreaders after frames have been built-in.
- 3.3.1.3 Make allowance for deflection to ensure structural loads are not transmitted to frame.

3.4 DOORS AND FRAMES

- 3.4.1 **General:** Install fire labeled doors and frames in accordance with NFPA 80.

3.4.2 Hollow Metal Doors Frames and Screens

- 3.4.2.1 Set door frames and screens plumb, square, level, maintaining widths and heights. Coordinate with Section 04 20 00, Masonry and Section 09 29 00, Gypsum Board for building in and anchoring of frames.

3.4.2.2 Brace frames rigidly in position while building in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame, rebate height to maintain frame width. Provide vertical support at centre of head for openings exceeding 1200 mm (48") in width. Remove wood spreaders after frames have been built-in.

3.4.2.3 Make allowance for deflection to ensure structural loads are not transmitted to frame.

3.4.2.4 Prior to installation apply urethane foam/vermiculite coating to inside face of door frame where sound resistant walls and doors with door bottoms are indicated on Drawings and Schedule.

3.4.3 Door Installation

3.4.3.1 Hang doors to swing shut with 1.6 mm (1/16") clearance at heads, 2 mm (3/32") at jamb and 6 mm (1/4") clearance over finished floor surfaces. Install doors so face on opening side is kept 1.6 mm (1/16") shy (recessed) from rebate even after bumpers are installed. (Check and comply with Door Schedule for conditions requiring greater clearance from floor for air movement and in areas to be carpeted.)

3.4.3.2 Install fire rated doors in accordance with NFPA 80 requirements.

3.4.3.3 Adjust operable parts for correct clearance and function.

3.4.3.4 Install metal louvres.

3.4.3.5 Trim non-rated door width by cutting equally on both jamb edges. Trim door height by cutting bottom edges to maximum of 19 mm (3/4"). Trim fire-rated door height at bottom edge in accordance to ULC requirements. After trimming door, have painter seal top and bottom edges of door under Section 09 91 00, Painting and Finishing.

3.5 FINISH HARDWARE

3.5.1 Take delivery of finish hardware and install, except hardware specified as part of work of another Section. Check each item as received.

3.5.2 Install finish hardware for fire rated doors in accordance with NFPA 80 requirements.

3.5.3 Set, fit and adjust hardware according to manufacturer's templates and instructions. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.

3.5.4 Install all hardware for doors.

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- 3.5.5 Consult with manufacturer of hardware items such as door monitoring equipment, card reader access equipment, electric strikes, and electric hinges operated by card access equipment and combination magnetic door holder releases/door closers and install in accordance with manufacturer's recommendations under supervision of Division 16. Provide adequate notice to Division 16 in advance of installation. Use templates as supplied by manufacturer for pre-drilling doors and frames.
- 3.5.6 Pre-drill kickplates and doors before attachment of plates. Apply with water resistant adhesive and countersunk stainless steel screws.
- 3.5.7 Weatherstrip wood and hollow metal doors for sound control. Install effectively to tightly seal entire perimeter of door. Secure in place with non-ferrous screws, in accurate alignment.
- 3.5.8 Maintain integrity of weather seal at head of doors fitted with closers. Adapt weatherstripping as required to achieve specified performance and provide any necessary accessories.
- 3.5.9 **General:** Supply and install all other carpentry indicated on Drawings or as required for completion of work. Co-operate with other trades in installing items supplied by other Sections, cut openings in woodwork when so required and make good disturbed surfaces.
- 3.5.9.1 Mounting Heights from finished floor:
- Lockset 1025 mm to centerline of strike plate
 - Exit Device refer to manufacturer's templates
 - Push/Pull 1065 mm
 - Deadlocks 1200 mm
- 3.6 **CLEANING**
- 3.6.1 On completion, remove manufacturer's identification markings and clean plastic laminate surfaces.

End of Section

PART 1 – GENERAL

1.1 SUMMARY

1. Products supplied under this section:

1. Vapour barrier and installation accessories for installation under concrete slabs.

1.3 SUBMITTALS

1. Quality control/assurance:

1. Summary of test results per paragraph 9.3 of ASTM E 1745.
2. Manufacturer's samples and literature.
3. Manufacturer's installation instructions for placement, seaming and penetration repair instructions.
4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

1.4 JOB MOCK UP

1. Submit mock-ups in accordance with Section 01300 - Shop Drawings, Product Data, Samples and Mock-up
2. Construct mock-up of sheet vapour barrier installation including one lap joint, and at one edge. Mock-up is to be part of wall specified.
3. Allow 24 hr. for inspection of mock-up by Architect before proceeding with vapour barrier work.

1.5 SPECIAL PROTECTION

1. Provide adequate protection of materials and work of this Section from damage by weather and other causes.
2. Protect the work of other Subcontractors from damage resulting from work of this Section. Make good such damage to the satisfaction of the Consultant.

1.6 REFERENCES

1. American Society for Testing and Materials (ASTM):
 1. ASTM E1745- 11Standard Specification for Plastic Water Vapour Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 2. ASTM E1643- 11Selection, Design, Installation, and Inspection of Water Vapour Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

2. Technical Reference - American Concrete Institute (ACI):

1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

PART 2 – PRODUCTS

2.1 MATERIALS

1. Vapour barrier shall have all of the following qualities:

1. Maintain permeance of less than 0.01 Perms [grains/(ft² · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
2. Other performance criteria:
 - a. Strength: ASTM E1745 Class A.
 - b. Thickness: 15 mils minimum

2. Vapour barrier products:

1. Stego Wrap Vapour Barrier 0.38mm (15-mil) by Stego Industries LLC., tel.: 877-464-7834. Approved alternate: W.R. Meadows, 'Perminator' (15 mil) Underslab Vapour Barrier by W.R. Meadows of Canada Ltd., tel.: 905-878-4122.
2. W.R. Meadows, SEALTIGHT Pre-moulded membrane vapour seal with plasmatic core by W.R. Meadows of Canada Ltd., tel.: 905-878-4122.

2.2 ACCESSORIES

1. Seams:

1. Stego Tape by Stego Industries LLC,

2. Penetrations of Vapour barrier:

1. Stego Mastic by Stego Industries LLC,
2. Stego Tape by Stego Industries LLC,

3. Perimeter/edge seal:

1. Stego Crete Claw by Stego Industries LLC,
2. Stego Tack Tape (double sided) by Stego Industries LLC,
3. Stego Term Bar by Stego Industries LLC,
4. For W.R. Meadows: Seam Tape: High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4 inches.
5. For W.R. Meadows: Pipe Boots: Construct pipe boots from vapour barrier

material and pressure sensitive tape per manufacturer's instructions.

PART 3 – EXECUTION

3.1 PREPARATION

1. Ensure that subsoil is approved by Architect or Geotechnical Engineer.

1. Level and compact base material.

3.2 INSTALLATION

1. Install vapour barrier in accordance ASTM E1643.

1. Unroll vapour barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 2. Extend vapour barrier over footings and grade beams to a distance acceptable to the structural engineer or stop at impediments such as dowels and waterstops.

[The perimeter seal recommendation can be addressed through various methods. When sealing to the slab, Crete-Claw is the preferred option. When sealing to an existing footing, grade beam, or stem wall, the most effective options include the use of StegoTack Tape, Stego Term Bar, or both.]

- 3a. Seal vapour barrier to slab perimeter/edge using Stego Crete Claw and remove dirt, debris, and mud from Crete Claw prior to concrete placement.

OR

- 3b. Seal vapour barrier to footing/grade beam with StegoTack Tape, Stego Term Bar, or both.

4. Overlap joints 6 inches and seal with manufacturer's tape.
 5. Apply tape/Crete Claw to a clean and dry vapour barrier.
 6. Seal all penetrations (including pipes) per manufacturer's instructions.
 7. No penetration of the vapour barrier is allowed except for reinforcing steel and permanent utilities.
 8. Repair damaged areas by cutting patches of vapour barrier, overlapping damaged area 6 inches and taping all sides with tape.

END OF SECTION

1. GENERAL

1. WORK INCLUDED

1. Materials and installation methods for air/vapour barrier located within cavity wall construction on warm side of insulation as detailed around window and door openings; at control joint and expansion joint locations; over roof parapets and curbs.
2. Materials and installation methods for air/vapour barrier located in the non-accessible part of non-masonry walls, such as roof tie-in to curtain wall and tie in over parapets and roof curbs on to roof deck.
3. Materials and installation to bridge and seal openings and penetrations of window frames, fasteners, ties, roof deck, structural steel and similar leakage paths in the wall.

2. QUALITY ASSURANCE

1. All Air/Vapour Barrier products shall be applied by a Contractor currently approved by Air/Vapour Barrier manufacturer and with mechanics with a minimum 5 years' experience with the installation of this specified system. Provide written evidence of approval.

3. SUBMITTALS

1. Product Data: Provide data on material characteristics, performance characteristics, limitations and independent air leakage, sustained wind load and gust wind test data.
2. Submit shop drawings indicating all details of connections to roof decks and masonry flashings.
3. Submit samples of air/vapour barrier membrane which has the factory applied identification of the manufacturer clearly marked on it.

4. DELIVERY AND STORAGE

1. Deliver materials in original unopened packaging with all labels intact.
2. When stored at the job site, materials shall be protected from the weather by the proper use of raised platforms and waterproof coverings. Pallets of membrane shall not be double-stacked on the job site. Materials should not be stored at continuous temperatures above 38 deg. C. (100 deg. F.). Consult precaution statements on product label before use.

5. MOCK-UP

1. Construct typical exterior wall sample panel 4'-0" (1200mm) long by 4'-0" (1200mm) wide, incorporating frame, insulation and junction with roof

membrane, illustrating materials interface and seals.

2. Locate where directed.
3. Allow 48 hours for inspection of mock-up by Architect before proceeding with air/vapour barrier work.

6. ENVIRONMENTAL REQUIREMENTS

1. Ensure application temperature and humidity recommended by material manufacturer is maintained before, during and after installation.

7. SEQUENCING

1. Sequence work to permit installation of materials in conjunction with related materials and seals.

8. COORDINATION

1. Coordinate Work of this Section with all sections referencing this Section.

9. WARRANTY

1. The product manufacturer shall provide a certificate certifying the performance of his products for a period of 5 years from date of acceptance.
2. The installation contractor shall provide a certificate certifying all Work shall remain in place as installed free from any membrane defect for a period of 5 years from acceptance.

2. PRODUCTS

1. MATERIALS

1. Air/Vapour Barrier: (torch applied) Bakor "Blueskin TG" SBS modified bitumen, reinforced thermofusible membrane, with an average thickness of 100 mils. Membrane is a torch applied membrane. Approved alternate: 3M – 3015NP. "Blueskin SA" is accepted for use on non-masonry substrates.
2. Transition Membrane: Same as Air/Vapour barrier, Bakor Blueskin SA may be used in heat sensitive areas.
3. Primer for "Blueskin TG": Bakor 930-18.
4. Air barrier sealant: Bakor Air Bloc 21 or 230-21 Adhesive.
5. Air Barrier sheet membrane: Bakor Blueskin VP 160 peel and stick membrane. Approved alternate: SRP AirOutshield SA 280, 3M – 3015VP.

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6. Substrate Cleaner: Mineral spirits or xylol.
 7. Liquid Sealant (Around Openings, Pipe Penetrations Prior to Membrane Installation): Bakor Air Bloc 21.
 8. End of Membrane Sealant: Bakor Air Bloc 06.
 9. Alternates: Air-Shield and Air-Shield LM by WR Meadows.

3. EXECUTION

1. EXAMINATION

1. Verify that surfaces and conditions are suitable prior to commencing work of this Section. Notify Architect in writing of any discrepancies. Commencement of work or any parts thereof will imply the acceptance of the substrate by the installer.
2. Ensure that:
 1. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.
 2. Concrete surfaces are cured and dry, smooth without large voids, spoiled areas or sharp protrusions.
 3. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.

2. PREPARATION

1. Remove loose or foreign matter which might impair adhesion of materials.
2. Fill any voids with mastic substrate filler.
3. Clean and prime substrate joint/connection surfaces to receive transition strip in accordance with manufacturer's instructions.

3. INSTALLATION OF PRIMER

1. All surfaces required by manufacturer to receive air/vapour barrier must be completely primed by lambs wool roller, brush or spray equipment.
2. Apply at a rate of 4m²/L (200ft²/gal) depending on porosity and texture of surface or as directed by manufacturer.
3. Primed surfaces not covered during the same working day must be reprimed.

4. INSTALLATION OF AIR/VAPOUR BARRIER AND TRANSITION MEMBRANE

1. Install membrane horizontally with the sheet starting at the bottom and work progressing up the wall in an overlapping shingle fashion.
2. Position membrane for alignment. When membrane is in place, cut for ties or projections. When membrane is in place, apply heat to the underside of the membrane by propane torch at the point of contact with the substrate. Apply sufficient heat to make the bitumen tacky and firmly press membrane onto substrate to ensure complete contact and bond for the full extent of the membrane.
3. Overlap all joints in membrane a min. 2" (51 mm) and use a heated trowel to fully seal laps.
4. All inside corners shall be double covered with initial strap of 12" (300 mm) width centred.
5. Construction and control joints, double ply covered with initial strip of 6" (150 mm) width and second strip of 18" (460 mm) width.
6. Areas around drains, piping, vents, etc. shall be liberally coated with Air Bloc 21 for radius of 6" (150 mm) around drain hub piping vents, etc. before and after application of membrane.
7. Seal around any openings with Air-Bloc 21 with a minimum 2 ½" (64mm) overlap.
8. Seal end of membrane where it meets the substrate at the end of the day's work with Air-Bloc 21.
9. At all detail areas ensure continuity of air/vapour barrier to ensure continuous air tightness, especially at all corners, junctions, window and door locations. In corners and difficult areas, use "Vedatex Adhesive" to allow for sealing and application of reinforcing pieces of membrane.
10. Mechanical attachment must be made at windows, doors, louvres and curtain walls as per manufacturer's recommendations.
11. Install membrane down over metal through wall flashings (by Section 04200) with a min. 2" (50 mm) overlap at end joints.
12. Ensure all projections, including wall ties, are properly sealed by using a heated trowel to butter compound at the interface.

5. PRECAUTIONS

1. Do not leave membrane exposed for more than 6 weeks. Install insulation as soon as possible to protect the membrane from damage by other trades.

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2. Provide support for air/vapour barrier system on back and/or bottom side where it crossed over gaps such as masonry wall cavities, etc. Use copper flashing to support air/vapour barrier at gaps.

6. JOB COMPLETION

1. The contractor shall inspect the completed membrane and correct all defects to meet the specification.
2. Clean up all debris, excess materials and equipment and remove from site.
3. Any drippage or spills of coating sealant, mastic or primers shall be cleaned.
4. The General Contractor shall restrict construction traffic and equipment movement near the completed air barrier to only essential related trades. For trades continuing to work near the completed air barrier, appropriate protection shall be provided.

End of Section

1. GENERAL

1. SCOPE OF WORK

1. Supply and install rigid insulation at roof parapets; roof curbs, foundations, below through wall flashing; below grade insulation, below interior floor slabs, exterior entrance concrete slabs, and elsewhere where indicated on drawings.
2. Refer to Section 07 52 00 for roofing insulation.

2. PRODUCTS

1. INSULATION BELOW GRADE AT BUILDING

1. Below Grade foundation Locations: To conform to CAN/ULC S701 Type 4, ship lapped / square edged – buttered with waterproofing membrane backup, extruded polystyrene rigid insulation to be "Styrofoam SM" with RSI 0.87 (R-5.0) minimum thermal resistance values per inch by DuPont de Nemours, Inc. or equal.
2. Below Grade, Slab on Grade, Frost Slab, Door Threshold Locations: To conform to CAN/ULC S701 Type 4, square edge, extruded polystyrene rigid insulation to be "Styrofoam SM" with RSI 0.87 (R-5.0) minimum thermal resistance values per inch by DuPont de Nemours, Inc. or equal.
3. Foam Insulation: Sprayed polyurethane foam to flame spread rating of less than 500, min. RSI 1.05 (R 6/1") at density of 32.8 kg/cu.m (2lb/cu.ft). Spray foam at voids and broken areas in the rigid insulation. Spray foam is for repairs only.

2. ADHESIVE

1. Cavity wall insulation board perimeter buttered edges: "Air-Bloc 21" by Bakor (air/vapour retarder, both)

Note:

Over exterior sheathing, on framed substrate systems where there is mineral wool insulation filling the voids with a continuous air/vapour barrier sealed on the interior side of the framing members, the exterior rigid insulation is not to be sealed around perimeters when the contractor does not install Cladmate as specified for breathability.

2. Adhesive for perimeter insulation below grade: to be CGSB 71-GP-24m equal to Bakor 230-3J.

3. EXECUTION

1. WORKMANSHIP

1. Work shall include rigid insulation in cavity walls, clear storey walls; roof parapets, roof curbs, below grade foundation perimeter and below concrete entrance slabs.
2. Surfaces to receive rigid insulation shall be clean, free of grease and oil, and reasonably smooth with no mortar or concrete pin projections.
3. Install insulation after building substrate materials are dry.
4. Prime surfaces before using asphaltic type adhesives.
5. Install all materials using adhesive or fasteners in strict accordance with manufacturer's installation instructions unless otherwise specified herein.
6. Ensure a uniform, continuous thermal barrier effect. Where insulation is to be provided under other Sections, co-ordinate the work such that the thermal barrier continuity is achieved.
7. Install insulation to maintain continuity of thermal protection to building elements and spaces.
8. Fit insulation closely around electrical boxes, plumbing and heating pipes and ducts, and other protrusions.
9. Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from damaged or broken edges. Use longest possible lengths to reduce number of joints. Keep insulation minimum 3" (75 mm) from heat emitting devices such as recessed light fixtures, and a minimum 2" (50 mm) from sidewalls of CAN4-S604 Type "A" chimneys and CAN1-B149.1 and CAN1-B149.2 Type "B" and "L" vents.
10. In multiple layer applications offset both vertical and horizontal joints.
11. Do not enclose insulation until it has been inspected.

2. BELOW GRADE FOUNDATION WALL

1. Install 75mm (3") minimum rigid insulation. Backfill gently at below grade perimeter foundation locations.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

4. BELOW GRADE – EXTERIOR HARD SURFACE LOCATIONS

1. Install 100mm (4") for 1220mm (4') minimum rigid insulation out below / underside all hard surface materials from building perimeters.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

5. BELOW SLAB ON GRADE – INTERIOR NON-HEATED SLABS

1. Install 75mm (3") x 610mm (24") vertical (on inside of foundation) and 50mm (2") x (1220mm (4') horizontal (underside slab on grade) minimum rigid insulation around building perimeters where more stringent insulation is not indicated / detailed on drawings – this is typically Zone 6.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

6. BELOW GRADE FROST SLAB LOCATIONS

1. Install 100mm (4") thick for 1220mm (4') horizontal out from all exterior frost slab foundation systems, then 50mm (2") for 1220mm (4') out from 4" thick insulation horizontal at all hard surface locations. Coordinate with typical frost slab plan detail.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

7. BELOW GRADE INSULATION AT DOOR THRESHOLDS

1. Install 50mm (2") x 200mm (8") minimum vertical rigid insulation below door thresholds between interior slab on grade and exterior frost slabs at every door threshold location.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

8. ABOVE GRADE ROOF PARAPETS AND CURBS

1. Cut and fit 75mm (3") minimum rigid insulation at tops and sides of roof parapets and curbs as detailed on drawings.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENT

2. This section includes closed-cell medium density spray applied polyurethane foam insulation, air barrier and vapour barrier.

1.2 REFERENCED STANDARDS

1. ASTM E-96 Standard Test Methods for Water Vapor Transmission of Materials.
1. CAN/ULC S705.1-15: Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density.
2. CAN/ULC S705.2-20: Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.
3. CAN/ULC-S710.1:2019 Standard for Bead Applied One-Component Polyurethane Air Sealant Foam, Part 1: Material Specification.
4. CCMC L- 1400 Evaluation of BASF WALLTITE® CM01 as an insulation and air barrier material.
5. Canadian Construction Materials Centre (CCMC) Evaluation Report CCMC 13659-R. Walltite CM01 Air Barrier System.
6. CCMC's Technical Guide, Air Barrier Systems for Exterior Walls of Low-Rise Buildings, MasterFormat Number 07272 (07 21 19.02).
7. Canadian Construction Materials Centre (CCMC) Technical Guide, Air Barrier Systems for Exterior Walls of Low-Rise Buildings, MasterFormat Number 07 27 09.01.
8. Quality assurance installation standards for application by certified contractors approved by CUFCA or Caliber.
9. Do elastomeric membrane installation in accordance with manufacturers printed application instructions, except where specified otherwise.

1.3 SUBMITTALS

1. Product Data: Provide data on material characteristics, performance criteria, and limitations.
1. Installer Qualifications: Submit proof confirming the installing contractor is certified by Caliber QA to perform the installation of the product or system specified or an application certified contractor approved by CUFCA.
2. Licensing of the installer is required by CAN/ULC S705.2-20 Installation Standard.

3. Manufacturer's Installation Instructions: Indicate preparation, installation requirements and techniques, product storage and handling criteria.
4. Submit samples of all materials in accordance with Section 01300.
5. Submit duplicate 12" x 12" samples of sheet membrane material.

1.4 PRODUCT, DELIVERY, STORAGE AND HANDLING

1. Deliver materials in original unopened containers.
2. Label containers with brand name, installation instructions and identification of various items.
3. Store materials except membrane between 15°C and 27°C. If exposed to lower temperature restore to acceptable level before using.
4. Store materials except membrane in dry area and protect.

1.5 QUALITY ASSURANCE

1. Contractor performing work under this section must be certified by Caliber QA or by CUFCA. The contractor is required by the CAN/ULC S705.2-20 to purchase and install, for this project, only material that conforms to the requirements of CAN/ULC S705.1-15 Material standard.
2. Applicators shall have their photo-identification certification cards in their possession and available on the project site, for inspection upon request.
3. Maintain one copy of installation manual on site.
4. The Licensed Installer shall conduct the on-site daily testing as required by the CAN/ULC S705.2-20 Installation Standard. The Licensed Installer shall complete the Daily Work Report as required by the CAN/ULC S705.2-20 Installation Standard. Upon request submit copy of all completed forms to Consultant prior to making application for payment.
5. Membrane: applied by applicator trained and approved by manufacturer for application of its products.
6. Applicators: minimum 5 years proven experience.
6. Membrane manufacturer's representative:
 1. Inspect substrate prior to commencement of work, during application of membrane and upon completion of work.
 2. Provide technical assistance to applicator and assist where required in correct installation of membrane.

1.6 QUALIFICATIONS

1. Installer to be a Qualified Applicator of the products from the manufacturer/distributor. Submit proof of status upon request.
2. Material manufacturer/distributor must have an on-site quality assurance program. Submit three copies of quality assurance program upon request.

1.7 SCOPE/LOCATION

1. At exterior masonry veneer cavity wall locations and any other locations, as noted on drawings.

1.8 ENVIRONMENTAL REQUIREMENTS

1. Maintain temperature and humidity recommended by the materials manufacturer before, during and after installation.

1.9 CO-ORDINATION

1. Co-ordinate the work of this section with all sections referencing this section.
2. Provide sprayed foam insulation/air-vapour barrier at masonry cavity wall locations, at curtain wall systems where spray foam is shown at cavity wall locations, and at all metal wall cladding cavity wall locations.

1.10 WARRANTY

1. Warrant work of this section against defects or deficiencies for a period of two years from date of substantial performance of the project.
2. Promptly correct, at own expense, defects or deficiencies which become apparent within the warranty period.
3. Obtain from the manufacturer a material guarantee stating that the membrane shall be free of manufacturing defects and premature deterioration for a period of ten years from date of final Certification of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

1. WALLTITE ® CM01 by BASF The Chemical Company as represented by Building Resource Inc. (1.416.410.4055).
2. Other acceptable product: HeatLok Soya HFO, by Demilic Canada (1.866.437.0223), Sealite One by Carlisle Spray Foam Insulation, Boreal Natural Elite by Genyk Inc., or Insulthane Extreme by Elastochem Specialty Chemicals Inc.

3. Insulation/ Air Barrier Material and Air barrier System: Closed cell, spray applied polyurethane foam, medium density, ccSPF meeting the requirements of CAN / ULC-S705-15, CAN / ULC S742 and the CCMC's Technical Guide, Air Barrier Systems for Exterior Walls of Low-Rise Buildings, MasterFormat Number 07272 (07 21 19.02). Certified by a third party as containing a minimum of 5% recycled content by mass of finished product. GREENGUARD Indoor Air Quality Certified by the GREENGUARD Environmental Institute. Product to utilize low GWP, HFO , Zero ODS (Ozone Depleting Substance) blowing agent.

1. Density (ASTM D1622) = 28.9 kg/m³ (1.8 lb/ft.³), minimum.
2. Long Term Thermal Resistance (LTTR) in accordance with CAN/ULC-S770-09, as per CAN/ULC-S705-15.

THICKNESS MM (INCHES)	R RSI VALUES
50.0 (1.97)	R 10.3 RSI 1.82
50.8 (2.00)	10.5 1.85
63.5 (2.50)	13.5 2.37
75.0 (2.95)	16.1 2.83
76.2 (3.00)	16.4 2.88
88.9 (3.50)	19.3 3.39
100.0 (3.94)	21.8 3.84
102.0 (4.00)	22.1 3.90

3. Flame Spread Classification as per CAN / ULC-S102, including S127, Flame Spread <500.
4. Compressive strength as per ASTM D1621, 201 kPa(29.2 psi)
5. Tensile strength as per ASTM D1623, >200kPa (>29 psi)
6. Open cell content as per ASTM D2856, 6%.
7. Water absorption as per ASTM D2842, < 0.4% by volume.
8. Water Vapour Permeance as per ASTM96,
 1. 50mm sample: <60 ng/Pa*s*m² (1.0 Perms).
9. VOC emissions - below the detectable limit after 24 hrs.
10. Modify spray foam to suit temperature application as per manufacturer's recommendations. Spray foam shall not have any, HFC, CFC or HCFC or any depletion substance affecting the ozone layer.

2.2 PRIMERS

1. As per manufacturer's recommendations and CAN/ULC-S705.2 for surface conditions, for oily steel surface like Z-Bar, steel deck roof or curtain wall pan, aluminum tube, PVC pipes, applied ADBOND 8388-1 adhesive primer, colour: red before spraying polyurethane foam.

2.3 AIR/VAPOUR BARRIER

1. Elastomeric Sheet Membrane Air/Vapour Barrier:
 1. To be used in areas including all control joints over parapet wall at roof locations down onto roof air barrier, and between all junctions of dissimilar materials. Install prior to the application of the insulation. Install in widths of min. 12" (300mm) with 6" (150mm) cover to each side of joints or onto dissimilar products; and at base wall flashing membrane with min. 8" (200 mm) upturn and extended out over concrete foundation wall and extended a min. 1/4" beyond. Once the curing time required by the membrane manufacturer has elapsed, a test must be conducted to verify adhesion between the membrane and the substrate. All adhesion tests must be performed using COM-TEN INDUSTRIES Series 301N1M equipment or an equivalent. If adhesion is lower than the required minimum of 100 kPa (15 psi), the membrane must be mechanically fastened.
2. Acceptable Products:
 1. Blueskin TG air/vapour membrane and "Blueskin SA" air/vapour membrane (at all heat temperature sensitive locations) complete with end of membrane and termination sealer "Air Block 06". Manufactured by Henry , PW 100/40 BH manufactured by Protectowrap, or equal by W. R. Meadows.
3. Upon Architect's approval, products that function better in cold weather to be used at no additional cost to the Owner.

2.4 APPLICATORS

1. Installers of spray polyurethane foam shall be trained by BASF in accordance with CAN/ULC S705.2-20 and certified by Caliber QA to install the system specified or by CUFCA.

2.5 COMPATIBILITY

1. Ensure that all materials used are compatible.
2. Provide proof of compatibility.

PART 3 EXECUTION

3.1 EXAMINATION

1. Verify that surfaces and conditions are ready to accept the Work of this section. Application of Work of this section shall be deemed acceptance of existing work and existing conditions. Report in writing defects in substrate which may adversely affect the performance of the foam insulation/air barrier.

2. Examine joints before sealing to ensure configuration, surfaces and widths are suitable for vapour barrier. Report in writing the locations of joints which are deemed unacceptable for the application of vapour barrier and/or air barrier.

3.2 PREPARATION

1. Surfaces to receive foam insulation/air-vapour barrier shall be free of frost, loose or foreign matter which might impair adhesion of materials.
2. Prepare surface by brushing, scrubbing, scraping, or grinding to remove loose mortar, dust, oil, grease, oxidation, millscale and other contaminants which will affect adhesion and integrity of the foam insulation/air barrier system. Wipe down metal surfaces to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the foam insulation. Ensure surfaces are dry before proceeding.
3. Prepare joints to receive foam air barrier sealant by brushing, scrubbing, wiping, scraping or grinding to remove loose mortar, dust, oil, grease, solvents, oxidation, mill scale and other contaminants which will affect adhesion and integrity of foam sealant.
4. Where joints between sheathing boards exceeds 6 mm apply air-vapour barrier membrane to lap onto each sheathing board a 3" (75mm) for a min. total width of 6" (150 mm).

3.3 APPLICATION

1. Apply sheet membrane air-vapour barrier and foam insulation/air-vapour barrier membrane materials over clean and dry surfaces.
2. Installation shall be in accordance with CAN/ULC S705.2-20 , sheet membrane air vapour barrier and foam insulation air-vapour barrier membrane manufacturer's recommendations for this application overlapping all joints of sheet membrane with minimum 4" (100 mm) laps. Seal all laps and termination joints with "Air Bloc 06".
3. Masonry contractor will ensure that the surface is prepared to meet the requirements specified by spray foam insulation / air-vapour barrier manufacturer.
4. Before commencing work, the contractor will ensure that environmental and site conditions are suitable for installation of materials in accordance with each manufacturer's recommendations and notify architect in writing of unsuitable surfaces and conditions.
5. Commencement of work shall imply acceptance of surfaces and conditions.
6. Apply foam insulation/air-vapour barrier in strict accordance with manufacturer's written instructions, specifications or recommendations.

7. Apply foam insulation/air-vapour barrier only when surfaces and ambient temperatures are within limits prescribed by the material manufacturer.
8. Fill joints with foam sealant making allowances for post expansion of foam.
9. Finish joints shall be free from air pockets and imbedded foreign materials. Cut back excess foam sealant after cutting flush with surrounding surfaces unless otherwise directed and/or detailed.
10. Apply foam insulation/air-vapour barrier to a minimum 80 mm (3 1/4") thickness with a minimum two passes (min. 15mm, max. 50mm and allowing foam to cure between passes) to within the following tolerances: +6.4 mm (1/4"); - 0" (0 mm) thickness at all locations where cavity wall insulation/air barrier is shown on drawings and to provide a minimum R 18. Take particular care at base of wall and transition membrane flashing locations. First pass to create thin coat. 3 passes may be required at these critical areas.
11. Finished sprayed foam insulation/air barrier shall be free of voids and imbedded foreign materials.
12. Do not allow foam insulation to cover or mark adjacent surfaces. Use masking materials if necessary.
13. Remove over-spray and masking materials immediately after foam has cured to hard surface film.
14. Clean and make good surfaces soiled or damaged by work of this section. Consult with section of work soiled before cleaning to ensure methods used will not damage their work.
15. Do not permit adjacent work to damage work of this section. Damage to work of this section caused by other sections shall be made good by this section at the expense of the section which caused the damage.

3.4 FIELD QUALITY CONTROL

1. Site Tests:
 1. The Licensed Installer shall conduct daily visual inspection, adhesion/cohesion testing and density measurements as outlined by the CAN/ULC S705.2-20 Installation standard.
 2. The Licensed Installer shall complete the Daily Work Record and record all information required including the results of the testing. The Daily Work Record shall be kept on site for routine inspection. Copies of the Daily Work Record shall be forwarded to the owner or owner's representative upon request.
 3. Copies of the Daily Work Record or monthly summaries shall be sent to the Caliber Quality Assurance Program office on a monthly basis as required by Caliber, CUFCA, or other third party QAP as required by Demilic.

4. The costs incurred for daily testing and inspection by the Licensed Installer and the completion of the Daily Work Record shall be borne by the Licensed Contractor.
2. Inspection:
 1. Arrange for third party site-inspection by qualified inspection company/engineer. The cost of inspections shall be included in the bid provided by the Licensed Contractor.
 2. Arrange for third party site-inspection is required. The number of inspections is to be in accordance with the following schedule and is based on the area covered by spray foam insulation air vapour barrier system.
 3. For area insulation/air barrier system:
 1. 0-25,000 ft² – 1 inspection
 2. 25,001 – 50,000 ft² – 2 inspections
 3. 50,001 – 75,000 ft.² – 3 inspections
 4. 75,001 ft.² + - 4 inspections
 4. The 3rd party site-inspection shall verify conformance with the manufacturer's instructions, the CAN/ULC S705.2-20 Installation standard.
 5. If the inspection reveals any defects, the Licensed Contractor shall immediately rectify all such defects at his cost.

3.5 CLEAN UP

1. Clean up and remove all debris from site.

END OF SECTION

1. GENERAL

1. SCOPE

1. For filling gaps only in building envelope insulation system at penetrations and other areas as required to ensure a complete / sealed building envelope insulation system.
2. Fire resistive insulation where steel members penetrate roof and over any spray insulation which is exposed on the interior of the building.

2. DELIVERY

1. Packaging of insulation shall indicate manufacturer, type, density, and insulation value.

3. SAMPLES

1. Submit samples in accordance with Section 01 33 00.
2. Install sample installation min. 1'-0" (300 mm) long for each material proposed for project.
3. Submit material safety data sheets for materials of this Section.

2. PRODUCTS

1. MATERIALS

1. Sprayed-On Insulation: Foam insulation equal to Froth-Pak 2 Component Polyurethane Foam by DuPont de Nemours, Inc. with a min. R value of 5.5 per inch.
2. Sprayed Applied Fire Resistive Insulation: (at locations where spray foam insulation will remain exposed to the interior i.e. bottom steel framing that penetrates roof insulation for steel support structure that does not have insulation on the warm interior side) equal to Heat-Shield Sprayed-On Thermal Insulation by Cafco Industries Ltd.

3. EXECUTION

1. WORKMANSHIP

1. Insulation shall be applied by skilled workers, in accordance with best trade practices and manufacturer's printed instructions.
2. Do not install insulation in any part of the building where roof protection against inclement weather has not yet been provided and where the insulation could thereby be wet or damaged.

3. Examine joints before sealing to ensure that configuration, surfaces, and widths are suitable for spray-on insulation and service and that execution of sealing and performance of spray-on insulation will not be adversely affected. Defective work resulting from application to unsatisfactory joint conditions will be considered the responsibility of those performing the work of this Section.
4. Proceed with spray-on insulation only when air, substrate and surfaces in contact with spray-on insulation are completely dry.
5. Prepare joints by brushing, scrubbing, scraping or grinding inner surfaces to remove loose mortar, dust, oil, grease, oxidation, mill scale, and other materials which will affect adhesion and integrity of spray-on insulation and dry with clean cloths. Ensure that surfaces have not been coated with releasing agents, coating or other treatments, or that they are entirely removed.
6. Finished joints to be free of air pockets, imbedded foreign materials and cut back after curing to be flush with surrounding materials and recessed to sufficient depth for caulking.
7. Where spray-on insulation is to be applied at edges of insulation or at air/vapour barrier ensure that spray-on insulation is located to form seal at warm side of insulation and/or to form continuation of air/vapour barrier.
8. Protect all finished surfaces with appropriate covering during installation.
9. Install Sprayed-On Insulation and Sprayed Applied Fire Resistive Insulation as per manufacturer's recommendations.

2. LOCATIONS

1. Sprayed-On Insulation: Seal all joints where air leakage can occur, including at joist shoes, under base plates, between door and window frames and rough openings, around electrical and plumbing boxes and conduits that penetrate vapour barriers, around ceiling fixtures that penetrate roof deck. All other locations as specified and indicated on drawings, with foam spray-applied insulation where required to prevent movement or infiltration of air. Do also voids under window sills.
2. Sprayed Applied Fire Resistive Insulation: Install at structural penetrations through roof insulation at flat roof locations and as per drawings with a min. thickness of 4" (100 mm) with an R value of 16. Apply insulation a min. 8" (200 mm) beyond each side of structural element penetrating through roof insulation (i.e. roof screen support, roof hatch framing, roof curb support). Fill all voids at these areas. Install this insulation at all areas where spray applied insulation will remain exposed to the interior (including above acoustic tile and drywall ceiling locations).

3. CLEANING

1. Remove from surfaces of other work sealant smears, droppings and masking tape immediately after sealant has cured to a hard surface film.
2. Clean surfaces soiled by work of this Section. Do not use cleaning methods that will damage surrounding surfaces. Make good work cleaning has damaged under work of this Section.

End of Section

1. GENERAL

1. PRODUCT HANDLING

1. Deliver materials in original unopened packages bearing the name of the manufacturer, the brand and proper Underwriters Laboratories of Canada ULC/cUL/ULI labels for fire hazard and fire resistance classifications.
2. Keep materials under cover and free from dampness. All bags that have been exposed to water before use shall be discarded. Material is to be used before its expiration date.

2. SUBMITTALS

1. Comply with pertinent provisions of Section 01 33 00.
2. Submit the additional following data:
 1. Materials list of items proposed to be provided under this Section;
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
 3. It is the responsibility of the fireproofing contractor/applicator to submit specific U.L.C. cUL/ULI design numbers and to provide in writing confirmation that the Building Inspection Department accepts the submitted U.L.C. design system to achieve the required 1 hr. fire-resistance rating for all first floor steel columns and floor assemblies.

3. PRIOR TO APPLICATION OF FIREPROOFING MATERIAL

1. An inspection shall be made by this Contractor to see that all steel and other surfaces are acceptable to receive fireproofing.
2. Such inspection shall be made to see that all surfaces to be fireproof be free of oil, grease, dirt, scale, or any other substance that may impair proper adhesion.
3. If surface conditions are not satisfactory, it is the responsibility of this Contractor to notify the General Contractor of said conditions.
4. Where this Contractor proceeds with the work of this Section constitutes the acceptance of responsibility of said surfaces by this Contractor.

4. SCOPE OF WORK

1. Work Included:

1. Locations Include:

Fireproofing of exposed spray in place insulation, structural steel beams, steel columns, steel joists and any miscellaneous structural steel supporting rated assemblies. Sprayed fireproofing to provide rated protection equal to rating for floor assemblies as per CAN/ULC S101.

NOTE:

1. Typical rated floor assembly supported by steel beams on steel columns. Coordinate with structural drawings for locations of steel beams, and steel columns. Sprayed fireproofing shall be applied on all exposed supporting steel, beams, bridging and columns to provide **45 minute** rated protection. (to support 45 minute FRR roof)
2. At locations where spray insulation will remain exposed to interior of building, including above finished ceilings, (i.e. bottom of steel framing that penetrates roof insulation for roof screens, steel support structure that does not have insulation on the interior side such as at bottom area of angle supporting masonry veneer at low roof/high wall locations, attic spaces, crawl spaces), spray applied Fire Resistive Insulation to have a minimum thickness required by manufacturer.
3. Provide materials, labour, equipment and services necessary; furnish, deliver and install all work as shown on the drawings, as specified herein, and as needed for a complete and proper installation.

5. FIELD TESTS

1. If deemed necessary, the Architect may select, at the Owner's expense, an independent testing laboratory to sample and verify the thickness and density of the fireproofing in accordance with provisions of ASTM E605 "Standard Test Method for Thickness and Density of Sprayed Fire Resistive Material Applied to Structural Members".

Note: If initial tests show sufficient fire proofing has not been installed, this Trade Contractor will pay for all re-testing of non-conforming areas.

2. PRODUCTS

1. MATERIALS

1. Water: clean, fresh and suitable for domestic consumption and free from such amounts of mineral or organic substances as would affect the set of the fireproofing material.
2. Sprayed Fireproofing:
 1. Sprayed Fireproofing for exposed steel beams, the ULC design shall be equal to:
 1. Cementitious mixture AD Type 5GP (5MD where product is in contact or could be in contact to be more durable) by A/D Fire Protection U.L.C. design shall be equal to: a 1 hour ULC design type as required to suit the steel beams to meet ULC Design F906.
 2. Approved Alternative manufacturers are fireproofing by CAFCO Industries Ltd. and design shall be cUL Design D902 by CAFCO Industries, or Grace Construction Products Monokote MK-6 ULC Design F905.
 2. Sprayed fireproofing for steel columns, the ULC design shall be equal to:
 1. Cementitious mixture AD Type 5GP (5MD where product is in contact or could be in contact to be more durable) 1 hour U.L.C. Design type as required to suit column type.
 3. Note: Adjust the amount of fireproofing on the various beam sizes to achieve the required rating (i.e. at beams which are lighter than the minimum beam size required in the assembly). See formula in ULC, cUL/ULI fire resistance directory.
3. Fireproofing Sprayed on Sealer: equal to TC-55 by A/D Fire Protection Ltd.
4. Sprayed Applied Fire Resistive Insulation (at locations where spray insulation will remain exposed to the interior): A/D Type I by A/D Fire Protection Ltd. or Heat-Shield Sprayed-On Thermal Insulation by Cafco Industries Ltd.
5. Sprayed Applied Fireproofing to cover spray in place Insulation (at locations where spray in place insulation cannot remain exposed to the interior): A/D Thermal Barrier by A/D Fire Protection Ltd.

2. PERFORMANCE CRITERIA

1. The sprayed fireproofing shall have been tested by Underwriters Laboratories or other certified testing agency in accordance with the procedures of ASTM E119. (U.L.C. CAN 4-S101-M)
2. The sprayed-on fireproofing shall be Asbestos free, cementitious mineral fibre type. Approved performance criteria shall be:
 1. Material shall not crack or delaminate when the backing to which it is applied is subjected to a downward deflection of 1/20th of the span.
 2. The fireproofing subject to impact tests on a sample of the completed floor assembly shall not crack or delaminate from the surface to which it is applied. The test shall consist of 60 lb. (27 kg.) sand bag dropped from a height of 4'0" (1200 mm) onto the test specimen per ASTM E-760.
 3. The sprayed on fireproofing applied over uncoated and galvanized steel shall have a minimum bond strength of 295 lbs. per cubic foot (18.6 kPa), 360 Blaze II, when set and dry per ASTM E-736.
 4. The fireproofing material shall not be subject to losses from the finished application by sifting, flaking, or dusting.
 5. As a measure of the fireproofing material's ability to resist deformation, a sample of the material applied to a 6" x 24" (150 mm x 600 mm) galvanized steel sheet shall be subjected to a compressive load of 1,000 lbs. (454 kg.). The deformation of the material under these conditions shall be less than 10%.
 6. Bare, shop-coated and galvanized steel sheets with the fireproofing applied shall be kept at 90±3 degrees F. (30 degrees C. - 34 degrees C.) and 70±3% RH for a duration of 240 hours without evidence of corrosion of the steel.
 7. The fireproofing material shall have been subjected to abrading forces in accordance with ASTM Proposed Test Methods for Fire Resistive Materials. The abrasion when tested in accordance with this method shall be no more than 1.22 in. (31 mm).
 8. The fireproofing material shall have been subjected to impact penetration tests in accordance with test procedures per ASTM E-760 Proposed Test Methods for Sprayed Fire Resistive Material. Samples of the material when subjected to impact forces shall not show an impact loss greater than .31 cubic in. (50.8 cubic mm).
 1. The fireproofing density shall conform to ASTM E-605 a

minimum 13 pcf (208kg/m³).

3. The sprayed on fireproofing shall be compatible to provide the proper adhesion with the red primer installed on the steel columns, beams and bridging by the Steel Trade Contractor.

3. EXECUTION

1. GENERALLY

1. All clips, hanger supports, sleeves and other attachments to the fireproofing bases, as covered under other sections of the specifications, are to be placed by others, prior to the application of the fireproofing material, where these attachments can be anticipated in advance.
2. Ducts, piping, conduit or other suspended equipment that interfere with the uniform application of the fireproofing material shall be positioned after the application of the sprayed fireproofing.

2. APPLICATION

1. Apply the approved material to the steel members as needed to achieve the designated fire-resistivity in strict accordance with the manufacturers recommendations as approved by the Architect and the Building Inspection Department and Governmental agencies having jurisdiction.
2. Application of sprayed fireproofing shall be installed by experienced craftsperson.
3. Fireproofing shall be to the steel beams, and column assemblies.
4. No fireproofing shall be applied prior to completion of concrete work on steel decking.
5. Temperature and enclosure conditions shall be as required by the fireproofing manufacturer.
 1. An air and substrate temperature of 40 degrees F. (4 degrees C.) shall be maintained for 24 hours before and after application of the fireproofing.
 2. Provisions shall be made for ventilation to properly dry the fireproofing after application. In enclosed areas lacking natural ventilation air circulation and ventilation is to be provided.
6. Patching and repairing of sprayed fireproofing damaged by other trades, shall be performed under this Section and paid for by the trade(s) causing the damage.

7. Sprayed Applied Fire resistive Insulation: Install at all roof wall locations and at structural penetrations through roof insulation at roof metal deck locations as per drawings with a in. thickness of 3" (75 mm) with an R value of 12.3 (R.S.I.2.17). Apply insulation a min. 8" (200 mm) from roof deck down onto block walls and a min. 6" (150 mm) from block wall across onto metal deck. Apply insulation a min. 8" (200 mm) beyond each side of structural element penetrating through roof insulation (i.e. roof screen support). Fill all voids at these areas. Install this insulation at all areas where spray applied insulation will remain exposed to the interior (including above acoustic tile and drywall ceiling locations).

3. CLEAN-UP

1. After completion of the fireproofing work, equipment shall be removed and all exposed wall and floor areas shall be cleaned of deposits of sprayed fireproofing materials.

End of Section

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this Section and shall apply as if repeated here.

1.2 WORK INCLUDED

1. Firestopping and smoke seals at wall to floors and roof assemblies above at all corridors and all other vertical fire separations, at all fire rated walls (including 0 hr. rated walls), at both drywall and masonry walls. Mechanical/Electrical Sections of firestopping and smoke seals shall be by Mechanical and Electrical Contractors where their equipment and materials penetrated rated walls.

1.3 SAMPLES

1. Submit samples in accordance with Section 01300 – Submittals.
2. Submit 1'-0" (300 mm) x 1'-0" (300 mm) sample of each actual firestop material proposed for project.

1.4 QUALITY ASSURANCE

1. Applicator shall be licensed by the manufacturer of fireproofing materials with minimum three years documented experience for installing firestopping and smoke seal systems.
2. Submit manufacturer's certification that materials meet or exceed specified requirements.
3. Product manufactured under ULC Follow-up Program. Each container or package shall bear ULC label or listing mark.

1.5 SHOP DRAWINGS

1. Submit shop drawings and product data in accordance with Section 01300 – Submittals.
2. Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.
3. Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

1.6 SEQUENCING AND SCHEDULING

1. Sequence work to permit installation of firestopping and smoke seal materials to be installed after adjacent work is complete and before closure of spaces.

1.7 MUNICIPAL AUTHORITY APPROVAL

1. Discuss firestopping and smoke seal requirements with municipal building inspector to obtain their approval prior to installation. Determine which products and/or procedures will be required to obtain final approval.
2. Submit in writing, prior to commencing installation, full detailed descriptions of materials and methods to be employed for firestopping work to achieve full final approval of authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MATERIALS

1. Firestopping and smoke seal systems: A/D FIREBARRIER Firestop Systems by A/D Fire Protection Systems Inc., capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN4-S115-M85, and not to exceed opening sizes for which they are intended. Other manufacturers shall not be used unless approved in writing (5) days prior to tender closing. Approved Alternate Manufacturer: Tremco Ltd., Fire Stopping Systems.
2. Mineral Wool Backing Insulation: ULC Labelled, preformed non-combustible material A/D FIREBARRIER Mineral Wool by A/D Fire Protection Systems Inc.
3. Firestopping Sealant: ULC labelled, single component silicone based, A/D Silicone FIREBARRIER Sealant by A/D Fire Protection Systems Inc.
4. Firestopping Seal: ULC labelled, single component water-based seal, A/D FIREBARRIER Seal by A/D Fire Protection Systems Inc.
5. Spray-On Firestopping Sealant: ULC labelled, high performance single component, water-based, elastomeric acrylic firestop sealant, "TREMstop Acrylic SP" (sprayable grade) by Tremco Ltd.
6. Fire resistance rating of installed firestopping assembly not less than the fire resistance rating of surrounding floor and wall assembly as indicated on the drawings.
7. Firestopping system at openings around penetrations for pipes, ductwork, conduit and other mechanical and electrical items requiring sound and vibration control; elastomeric sealant type with mineral wool; do not use a cementitious or rigid seal at such location.

8. Primers: to manufacturer's recommendation for specific material, substrate, and end use.
9. Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
10. Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
11. Sealants for vertical joints: non-sagging.
12. Firestopping mortar is not acceptable for this project.

PART 3 EXECUTION

3.1 EXAMINATION

1. Examine existing conditions to receive this work prior to submitting shop drawings.
2. Examine surfaces to receive work of this Section and report any defects which may affect the Work of this Section.
3. Verify that openings are ready to receive the Work of this Section.
4. Confirm compatibility of surfaces to receive firestopping and smoke seal materials.
5. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 PREPARATION

1. Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are dry and frost free.
2. Prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instructions.
3. Maintain insulation around pipes and ducts penetrating fire separation.
4. Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

1. Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.

2. Seal holes or voids made through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained. For vertical sections, sealant is required only on the top side of the mineral wool. It is required on both sides for horizontal sections except only one side on '0' hour rated walls.
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 a neat finish.
5. Remove excess compound promptly as work progresses and upon completion.
6. Install firestopping with smoke seal sealant on both sides of all fire rated walls except for '0' hour rated walls where sealants is required continuously only one side of mineral wool backing insulation.

3.4 INSPECTION

1. Notify architect when ready for inspection and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies.
2. Arrange for final inspection of the work of this Section by firestopping manufacturer and municipal building inspector prior to concealing or enclosing work. Make corrections required.

3.5 SCHEDULE

1. Fire and smoke seal at all fire separations including 0 hour separations, and at locations as follows:
2. Generally, all locations required by code.
3. Penetrations through fire resistance rated (including 0 hour rated fire separations) masonry and concrete walls (except mechanical and electrical penetrations which will be firestopped by the mechanical and electrical contractors).
4. Top of fire resistance rated masonry and gypsum rated partitions and walls (Includes corridors noted as 0 hr. fire rating)

NOTE: Refer to Architectural drawings for locations of vertical fire separations.

5. Intersection of fire resistance rated masonry.
6. Control and sway joints in fire resistant rated masonry.
7. Penetrations through all floor slabs and fire rated ceilings (except mechanical and electrical penetrations which will be firestopped by the mechanical and electrical contractors).

8. Openings and sleeves installed for future use through fire resistant rated separations.

3.6 CLEAN-UP

1. Remove excess materials and debris and clean adjacent surfaces immediately after application.
2. Remove temporary dams after initial set of firestopping and smoke seal materials.

3.7 CERTIFICATION

1. The manufacturer of the firestopping and smoke seal products shall inspect each application on site and certify in writing its fire rating.
2. Costs for manufacturer's site inspection of firestopping and smoke seals application and certification shall be included in this Contractor's Section base bid.

END OF SECTION

1. GENERAL

1.1. INTENT

- 1.1.1. Provide for the proper and complete installation of all roofing and flashings as required to prevent entry of moisture into the insulation and structure below the roofing and flashing.

1.2. QUALIFICATIONS

- 1.2.1. Work shall be executed by an applicator who has adequate plant, equipment and skilled tradesmen to perform this work expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past five years. Likewise applicator must be a member of the C.R.C.A. and a member in good standing with the appropriate provincial roofing contractors association.
- 1.2.2. Applicator must be approved by the Consultant, Owner and the roofing material manufacturers.
- 1.2.3. Applicator shall provide a list of a least five (5) projects available for inspection employing same roofing system within 200km. radius of the project.
- 1.2.4. The intent is to have a complete roofing system provided by one manufacturer. The following manufacturers are considered to have equivalent systems/products suitable for use on this project; Siplast, Garland, Tremco, Soprema, IKO, Bakor.

1.3. REFERENCES

- 1.3.1. CSA - Canadian Standards Association
- 1.3.2. CGSB - Canadian General Standards Board
- 1.3.3. ULC - Underwriters Laboratories of Canada
- 1.3.4. FM - Factory Mutual Engineering Corporation
- 1.3.5. CRCA - Canadian Roofing Contractors Association
- 1.3.6. ASTM – Standards Test Methods for Sampling and Testing Bitumen Saturated Felts and Woven Fabrics for Roofing and Waterproofing.

1.4. ADMINISTRATIVE

- 1.4.1. Submit to the Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such

default will be allowed.

- 1.4.2. Work affected by submittal shall not proceed until review is complete.
- 1.4.3. Present shop drawings, product data, samples and mock-ups in SI Metric units.
- 1.4.4. Where items or information is not produced in SI Metric units converted values are acceptable.
- 1.4.5. Review submittals prior to submission to the Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.
- 1.4.6. Notify the Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- 1.4.7. Contractor is responsible to verify field measurements and all site conditions including adjacent properties and roof areas.
- 1.4.8. Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- 1.4.9. Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by the Consultant's review.
- 1.4.10. Keep one reviewed copy of each submission on site.

1.5. SHOP DRAWINGS & PRODUCT DATA

- 1.5.1. The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.
- 1.5.2. 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 coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- 1.5.3. Allow 7 days for Consultant's review of each submission.
- 1.5.4. Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Consultant prior to proceeding with Work.

- 1.5.5. Make changes in shop drawings as the Consultant may require, consistent with Contract Documents. When resubmitting, notify the Consultant in writing of any revisions other than those requested.
- 1.5.6. Accompany submissions within 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.

Submissions shall include:

 1. Date and revision dates.
 2. Project title and number.
 3. Name and address of:
 4. Subcontractor.
 5. Supplier.
 6. Manufacturer.
 7. Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 8. Details of appropriate portions of Work as applicable:
 9. Fabrication.
 10. Layout, showing dimensions, including identified field dimensions, and clearances.
 11. Setting or erection details.
 12. Capacities.
 13. Performance characteristics.
 14. Standards.
 15. Operating weight.
 16. Wiring diagrams.
 17. Single line and schematic diagrams.
 18. Relationship to adjacent work.
- 1.5.7. After Consultant's review, distribute copies.
- 1.5.8. Submit 3 prints of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.
- 1.5.9. Submit 3 copies of product data sheets or brochures for requirements requested in Specification. Sections and as requested by the Consultant where shop drawings will not be prepared due to standardized manufacture of product.
- 1.5.10. Delete information not applicable to project.
- 1.5.11. Supplement standard information to provide details applicable to project.

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

1.5.13. The review of shop drawings by the Consultant is for sole purpose of ascertaining conformance with general concept. This review shall not mean that the Consultant approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents. Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of all sub-trades.

1.6. HANDLING & STORAGE OF MATERIALS

1.6.1. Handle and store materials carefully to prevent damage. Manufacturer's labels, seals and identification shall remain intact. Store containers upright and roll materials on end to prevent flattening. Protect materials from moisture at all times.

1.6.2. Deliver materials in sufficient quantities to allow for continuity of work.

1.6.3. Co-ordinate delivery with Owner.

1.6.4. Store materials marked "keep from freezing" in areas where temperatures will remain above 4°C (40°F).

1.6.5. Contractor shall assume responsibility for the protection and safekeeping of products stored on the job site.

1.6.6. Provide a continuous fence at grade level around all machinery, material and equipment 7'6" in height with welded mesh and welded tubing that includes a gate/door with locking gate to meet or exceed manufacturer's recommendations.

1.6.7. The Contractor's materials and equipment shall be kept orderly and shall not encumber operations of facilities. Job site shall be maintained free of marketing signage.

1.7. INSPECTION & TESTING

1.7.1. Inspection & Testing for work of this section shall be paid from the cash allowance listed in Section 01 02 00.

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- 1.7.2. Roofing shall be completed in strict accordance with specifications, conforming to best trade practice and to the satisfaction of the Owner or his authorized representative. Afford facilities and access for inspecting the work as required and immediately act upon instructions given.
 - 1.7.3. Notify inspection authority minimum two working days in advance of commencing work and provide further notification as required due to temporary postponement of work, etc.
 - 1.7.4. Make and repair all cut tests for testing purposes at locations requested. Cut tests will be made during progress of work or on completion of work. Wherever possible, tests will be made before workmen have left the site, all at no additional cost to the contract.
 - 1.7.5. Samples of roof membrane from cut tests and samples of material taken from containers may be kept by the Consultant. These samples may be submitted to an independent laboratory for testing purposes. Cut test locations should be reinstated with material and installation as specified immediately after cut tests have been provided.
 - 1.7.6. Should test results prove that a material is not functionally equal to specified material:

Contractor shall pay for all additional testing. Roofing installed and found not to comply with the specifications shall be removed and replaced at no change in the contract price.
 - 1.7.7. Membrane manufacturer to inspect installation to ensure compliance with product application requirements. It is the Contractor's responsibility to arrange with the manufacturer's representative to provide inspections. The manufacturer's representative shall visit the project during the course of roofing work often enough to ensure that the work is being undertaken in accordance with the manufacturer's written recommendations. The Consultant shall be notified of all such visits in writing.
 - 1.7.8. When all work is substantially completed the Roofing Contractor shall arrange for an inspection. At this time the Roofing Contractor's superintendent and foreman should be present. The Roofing Contractor should also arrange for the manufacturer's representative of the roof membrane to be in attendance.
 - 1.7.9. If work is deemed incomplete or discrepancies are found by the Consultant, complete the outstanding items and rearrange for a further inspection.
 - 1.7.10. The Roofing Contractor shall correct all deficiencies before a date agreed upon by the Consultant and Owner.
 - 1.7.11. The inspection and testing service does not relieve the Contractor's responsibility for quality control of production and for errors made the

Contractor.

1.8. REJECTED WORK

- 1.8.1. 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.
- 1.8.2. Make good other Contractor's work damaged by such removals or replacements promptly.
- 1.8.3. If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Consultant.

1.9. EXAMINATION

- 1.9.1. Prior to commencement of work, examine surfaces and ensure that defects of level or construction are corrected before proceeding with work. Commencement of work shall imply acceptance of surfaces.

1.10. WORK RESTRICTIONS

- 1.10.1. Do not load or permit any part of the structure to be loaded with a weight that will endanger its safety. Questions of structural loading as part of construction means and methods shall be addressed by a licensed Structural Engineer engaged by the Contractor.

1.11. CO-ORDINATION

- 1.11.1. Co-ordinate work with other trades and ensure all openings, drains pipes, sleepers, etc., are installed and flashed at the appropriate time.
- 1.11.2. Co-ordinate work with work of asphalt shingle roofing.
- 1.11.3. Co-ordinate progress of the work, progress schedules, submittals, use of site temporary utilities and construction facilities.
- 1.11.4. The Contractor shall have a competent foreperson or superintendent on the job site at all times during the execution of the contract when work is in progress. This foreperson shall not be changed without permission unless the Consultant deems that this foreperson is unsatisfactory to carry out the work, or if the foreperson's employment is terminated. This foreperson shall represent the Contractor for each specific phase and any minor direction given this foreperson will be held as being given to the Contractor.

- 1.11.5. It shall be the responsibility of the Contractor's foreperson to inform General Contractor which areas are to be worked upon and to determine what measures may be necessary to limit disruption of the building activities to a minimum.

1.12. PROTECTION

- 1.12.1. Protect the building and work of other trades from soiling and other damage. Damage to the building as a result of this work shall be repaired as instructed, all at no extra cost to the contract. Protect the interior of the building as required and directed.
- 1.12.2. Contractor shall be responsible for protection of property during course of work. Lawns, shrubbery, paved areas and building including interior shall be protected from damage. Repair damage at no extra cost to contract.
- 1.12.3. Roof installation shall be scheduled in such a manner that traffic over new roofing is eliminated. Wherever traffic cannot be avoided, adequately protect roof areas with plywood sheathing, etc. Damage to roofing shall be repaired as instructed by the Owner or authorized representative at no extra cost to the contract.
- 1.12.4. Arrange work sequence to avoid using newly constructed roofing for storage, walking surface or equipment movement.
- 1.12.5. Protect building surfaces at set-up areas with tarpaulin and secure tarpaulin. Spilled or scattered debris shall be cleaned-up immediately. Removed material to be disposed from roof as it accumulates.

1.13. CONSTRUCTION SAFETY MEASURES

- 1.13.1. Observe construction safety measures of Provincial Government, Workers'/Workmen's Compensation Board and municipal authority provided that in any case of conflict or discrepancy more stringent requirements shall apply.
- 1.13.2. In event of conflict between any provisions of above authorities the most stringent provision will apply.
- 1.13.3. The Contractor shall comply with the safety regulations presently in effect in this Province and shall provide such supervision and apparatus necessary for the safety of all concerned.
- 1.13.4. All application, material handling, and associated equipment shall conform to and be operated in conformance with the guidelines as outlined by the "Workplace Hazardous Materials Information System" (WHMIS), the Ministry of Labour, the Occupational Health and Safety Act (OS) and the "Foreman's Safe Roofing Guidelines".

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- 1.13.5. The Contractor must follow the Ministry of Labour's guidelines and recommendations. The Consultant is to receive a copy of this document.
 - 1.13.6. Comply with federal, provincial, local and Owner's fire and safety requirements.
 - 1.13.7. Maintain fire extinguisher equipment in sufficient quantity and size as per Provincial Health and Safety Regulations and within easy access whenever power tools, roofing kettles and torches are being used.
 - 1.13.8. Ensure that no part of the building is subject to a load, which will endanger its safety or cause permanent deformation.
 - 1.13.9. The Contractor will adequately train and instruct workers in accordance with WHMIS requirements and will provide the Owner with detailed information with respect to the training provided to workers, the language in which instructions are given and a copy of training manuals used.
 - 1.13.10. The Contractor will consult with the Consultant and if required further consult with Ministry of Labour co-ordinator regarding the physical set up of the job site and comply with any orders of the co-ordinator in that regard.
 - 1.13.11. The Contractor will supply the Consultant with a list of hazardous materials to be used and "Material Safety Data Sheets" for them to be kept, in a readily accessible location for the duration of the project.
 - 1.13.12. The Contractor will not bring any controlled products onto the Owner's property that are not labelled in accordance with WHMIS requirements.
 - 1.13.13. The Ministry of Labour co-ordinator is permitted to inspect the work site at any time and to speak to workers to determine the adequacy of their safety knowledge if they consider it necessary. Any violation of Ministry of Labour requirements may result in work being stopped until they are rectified. Repeated or serious violations may result in cancellation of the contract.
 - 1.13.14. The Contractor will indemnify the Owner for any costs the Owner incurs as a result of his failure to comply with Occupational Health and Safety Act.
 - 1.13.15. Provide and maintain protection and warning signs at all areas, which may be dangerous to the occupants or the public.
 - 1.13.16. Remove all ladders from the building at the end of each working day to prevent unauthorized access to the building and cause possible damage.
 - 1.13.17. Disconnect propane burners from bottles at the end of each working

day. Store propane bottles in protected area away from ignition source and building.

1.13.18. Contractor's workers shall be properly protected and use all required protective clothing including face masks, goggles and gloves, etc.

1.13.19. Assume complete responsibility for construction strength, packing, anchoring and operation of derricks, cranes, hoists and other mechanical contrivances used for work; and ensure that loads carried thereon can be safely supported and be free from accidents to all persons.

1.13.20. Have hoist capacities, with regard to anticipate loads, verified by a Professional Engineer registered in this province.

1.14. ENVIRONMENTAL

1.14.1. Apply only dry materials and apply only during weather that will not introduce moisture into roofing system. Do not apply material during inclement weather or over damp, frozen or unsuitable substrate.

1.14.2. Do not install materials marked "keep from freezing" when daily temperatures are scheduled to fall below 4°C (40°F).

1.14.3. Do not perform masonry work below 2°C (35°F). Make proper provisions to protect work from freezing forty-eight (48) hours after layer if work is performed between 2°C (35°F) and 7°C (45°F).

1.14.4. Store solvent-soaked cleaning rags in approved containers in a location to prevent a threat to fire safety or health of the building occupants or workmen. Dispose from site daily.

1.15. MATERIALS SOURCE SEPARATION PROGRAM

1.15.1. Separate building materials for recycling that are to be removed from site.

1.15.2. Provide containers to deposit reusable and/or recyclable materials.

1.15.3. Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

1.15.4. Locate separated materials in areas which minimize material damage.

1.15.5. Collect, handle, and transport off-site, salvaged materials in separate condition. Transport to an appropriate recycling facility

1.16. WORKFORCE

1.16.1. Once roofing commences, work shall not be postponed for any reason other than weather. Roofing crew shall consist of qualified and experienced personnel and/or more if required due to size and/or schedule

of completion. The workforce shall not be changed without written permission from the Consultant.

1.17. GUARANTEE / WARRANTY

- 1.17.1. The Contractor represents that the Contractor has the special qualifications for doing the Work and that the plans and specifications are, in the Contractor's opinion, appropriate and adequate for the construction and/or renovations set out therein.
- 1.17.2. The Contractor and Subcontractor hereby jointly and severally warrant the work of this section, including roof membrane, vapour retarder, insulation and sheet metal work against any actual leakage for a period of two [2] years from the date of substantial performance, and agree to make good promptly any defects which occur or become apparent within the warranty period, such defects to include but not be restricted to leaking, failure to stay in place, undue expansion, lifting, deformation, loosening or splitting of seams, joint declaration, failure to adhere, deterioration, blisters, etc.
- 1.17.3. The Contractor shall furnish the guarantee/warranty in writing, on a form satisfactory to the Owner or the authorized representative signed.
- 1.17.4. The guarantee/warranty period shall commence from the day of substantial performance.
- 1.17.5. The specified roofing membrane system shall carry a manufacturer's extended limited warranty. The length of the warranty period shall be for a period of **twenty (20) years** from the date of substantial performance for materials, including labour, to repair leaking membrane and maintain the roofing membrane in a watertight condition.
- 1.17.6. The Contractor's guarantee and the manufacturer's extended warranty are to exclude: normal wear and tear, damage caused by neglect, carelessness or vandalism caused by the installation or removal of any equipment and or material built into or part of the roofing membrane system, damage caused by excessive traffic over the roofing membrane, or use of the roof area for the purpose that is was not intended, or damage structure building components and finishes or building contents.
- 1.17.7. The shipment of and arrival on the site of the manufacturer's materials will constitute the manufacturer's agreement to warrant the roof in accordance with the conditions as outlined above.
- 1.17.8. The Owner's representatives are to conduct an inspection of the project 60 days prior to the expiration of the two [2] year roofing guarantee. The Contractor will be contacted at the time if any deficiencies related to the guarantee and/or long-term warranty are evident and will require attention. The Contractor will correct the deficiencies before the expiration of the Contractor's guarantee or make arrangements for the correction.

1.18. COMPLETION

- 1.18.1. Clean-up and remove all debris, surplus materials, tools and equipment, etc., upon completion of work to the satisfaction of the Consultant.

1.19. WORKMANSHIP

- 1.19.1. Workmanship shall be of the highest quality. Use competent trades people and execute work in accordance with contract documents.
- 1.19.2. Regard manufacturer's printed recommendations and latest literature as the minimum requirement for materials, method and procedures.
- 1.19.3. Notify the Consultant should the specifications conflict with the manufacturer's recommendations, otherwise it will be assumed that the Contractor and manufacturer are in agreement with procedure outline.
- 1.19.4. Advise the Consultant of adjustments to specified roofing procedures recommended by manufacturers caused by weather and site conditions. Make adjustments to specified procedure only after review with the Consultant, and receive approval in writing.
- 1.19.5. When roofing operations require open torch operation advise Roofing Consultant of nature of work. In such cases higher safety and insurance limits may be imposed. Any additional cost to meet these requirements will be at the Contractor's expense.
- 1.19.6. Unsuitable or damaged materials shall immediately be removed from the site.
- 1.19.7. Wherever two or more plies of membrane are applied, the second ply, etc., shall extend minimum 6" (150mm) beyond the termination of the previous ply of membrane.
- 1.19.8. Roof curb and sleeper heights shall be minimum 12" (300mm) measured from the surface of the completed roof system to the top. This applies to prefabricated curbs and sleepers as well as those provided by the carpenters.
- 1.19.9. Inspect the underside of the deck to ensure fasteners will not be visible or damage the structure, interior surfaces or affect electrical and mechanical services. Investigate the location of all hidden services which include mechanical, electrical, cable, security, fire alarms which may be installed under the deck.

1.20. INSPECTION & DECLARATION

- 1.20.1. Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as

required to conform to Contract Documents. Notify the Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made. Request Consultant's Inspection.

- 1.20.2. Consultant's Inspection: Consultant and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- 1.20.3. Completion: submit written certificate that following have been performed: Work has been completed and inspected for compliance with Contract Documents. Defects have been corrected and deficiencies have been completed. Equipment and systems have been tested, adjusted and balanced and are fully operational. Operation of systems have been demonstrated to Owner's personnel. Work is complete and ready for Final Inspection.
- 1.20.4. Final Inspection: when items noted above are completed, request final inspection of Work by Consultant, and Contractor. If Work is deemed incomplete by Consultant, complete outstanding items and request re-inspection.

1.21. SHEET METAL WORK

- 1.21.1. Sheet metal work shall be of the highest quality installed in accordance with best trade practice and to the following requirements.
- 1.21.2. Apply two coats of bituminous back paint to all surfaces of metal in contact with masonry, concrete or dissimilar metals.
- 1.21.3. Seams shall be of the "slip lock type" that permit adequate movement without resulting in deformation or loosening of metal flashings. Lapped joints or exposed raw edges will not be accepted. Exposed edges shall be "doubled back" at least 1/2" (12.5mm). At eaves, parapets, etc., metal shall be hooked over continuous starter strips minimum one gauge thicker than the metal used for flashing. Secure starter strips at 12" (300mm) on centre or closer as required.
- 1.21.4. Fabricate all possible work in shop in maximum 8' (2450mm) lengths by brake forming, bench cutting, drilling and shaping. On vertical sections or horizontal planes greater than 30" (750mm) install metal in 4' (1200mm) section unless otherwise specified or shown.
- 1.21.5. Space joints evenly where exposed. When flashing is being installed in more than one piece, offset joints in adjacent flashings by approximately 50%.
- 1.21.6. Form inside and outside corners by means of standing seams.
- 1.21.7. Slope all metal to interior to maintain minimum 8% slope. Do not form metal in a manner where water will pond on top of metal flashing.

- 1.21.8. Where metal terminates under fascia boards, secure metal at 24" (600mm) on centre using specified fasteners. At curbs to openings or at sleepers, etc., provide locked or standing seams at corners.
- 1.21.9. Where metal flashings enter reglets, ensure reglet is minimum 3/4" (18.75mm) deep and minimum 3/8" (9.37mm) wide. Metal flashing portion that enters reglet shall extend the full depth and be complete with a 3/8" (9.37mm) return upstand to permit proper securement in the reglet. Secure metal flashings in reglets at 24" (600mm) centres and further secure metal to vertical surface at locks.
- 1.21.10. At reglets wider than 3/8" (10mm) and deeper than 3/4" (19mm) provide polyethylene rod, 25% wider than joint width.
- 1.21.11. All flashings shall be installed in perfectly straight lines. Irregular or badly fitted work will not be accepted. Exposed fastenings will only be permitted where concealed fastening is impossible. Provide neoprene washers at exposed fastenings.
- 1.21.12. Where sheet metal counter-flashings are the only form of waterproofing, provide waterproofing underlayment prior to installing metal. Overlaps of underlayment shall be minimum 2" (50mm) and end laps minimum of 6" (150mm).

1.22. SAMPLES OF SHEET METAL FLASHINGS

- 1.22.1. Install mockup samples of metal flashings indicating method of joints, fastening, seams, expansion joints and stiffeners for approval by Consultant or Owner prior to fabrication.
- 1.22.2. Commencement of metal flashing installations implies that this Contractor has accepted the surfaces as satisfactory and accepted responsibility for appearance of completed work.

1.23. SCOPE OF WORK

- 1.23.1. Unless specified otherwise supply and install sheet metal counter-flashings at perimeters, walls, parapets and curbs, etc., as required and directed.
- 1.23.2. Unless specified otherwise supply and install wood sleepers, to support equipment at locations directed, complete with wood blockings and cant strips minimum 12" (300mm) high measured from surface of completed roof. Sleepers shall be covered with membrane flashings and metal counter flashings. Construct sleepers using continuous 2 x 6 (50mm x 150mm) wood blockings.
- 1.23.3. Unless specified otherwise supply and install "stack jacks" specified. Trim height of existing pipes as required and/or extend existing pipes as

required and directed. Maintain a minimum height of 12" (300mm) above the completed roof surface.

- 1.23.4. Unless specified otherwise supply and install spun aluminum chimney stack base flashing complete with aluminum collars, etc., minimum 12" (300mm) in height.
- 1.23.5. Unless specified otherwise install roof drains supplied and specified by Division 15 – Mechanical.
- 1.23.6. Install Torch Safe strips at junction of vertical surfaces.
- 1.23.7. All conduits, piping, etc., that pass through sleeves and curbs to roof openings, etc., shall be installed by using products specified.
- 1.23.8. Parapet shall be totally covered with membrane flashings and sheet metal counter-flashings.
- 1.23.9. Unless specified otherwise supply and install gasline supports as specified. Provide 1/4" (6.25mm) space between the gasline clamp and the pipe itself. Gasline piping not in use shall be removed. All work relating to gaslines is to be completed by a licensed gas fitter. All gaslines are to be cleaned and painted.
- 1.23.10. Unless specified otherwise provide MERS-800A duct supports supplied by Thaler Metal Industries Ltd.
- 1.23.11. Where ductwork passes through the top of roof curbs provide tapered wood blockings surfaced with 1/2" plywood covered with membrane flashings extending minimum 12" up the vertical surface of the ductwork.
- 1.23.12. Where ductwork passes through walls extend modified membrane onto ductwork approximately 12" and ensure tapered insulation of ductwork slopes away from wall.
- 1.23.13. Where several pipes pass through the top of a large roof curb provide metal base flashings including metal cover and provide tapered wood blockings surfaced with 1/2" plywood completely covered with membrane flashings.
- 1.23.14. Where gaslines pass through the top of a roof curb, the roof curb is to be extended in height minimum 6" above gaslines where the gaslines will pass through the side of the curb.
- 1.23.15. Install all patio slabs for walkways as specified.
- 1.23.16. Supply and install scupper drains.
- 1.23.17. Supply and install fully tapered 2% polyisocyanurate insulation specified and provide additional slope if required to achieve positive drainage.

Roofing Contractor is responsible to ensure positive drainage.

- 1.23.18. Unless specified otherwise where rigid electrical conduits pass through roof supply and install electrical outpost supplied by Lexcor; where flexible conduits pass through the roof provide wire outlet post supplied by Lexcor.
- 1.23.19. Small mechanical units are to be supported on top of patio slabs as specified work walkways.
- 1.23.20. Configure roof curbs to suit cover of the exhaust fan units.
- 1.23.21. Provide high temp caulking sealant where hot pipes pass through top of curbs and base flashings and around collars.

2. PRODUCTS

- 2.1. Products shall conform to the requirements of jurisdictional authorities, to C.S.A and C.G.S.B. specification number named including all revisions to date.
- 2.2. Products substituted without prior written approval shall be removed from the site and areas disturbed shall receive specified products.
- 2.3. Compatibility of roof system components is essential and this shall be confirmed by the applicator.
- 2.4. Product data sheets and material data sheets shall be issued to the Consultant prior to ordering materials.
- 2.5. Submit sample of products prior to ordering and do not order products or start work before receiving Owner's written approval.
- 2.6. Asphalt primer – PA-917 LS primer conforming to C.G.S.B. specification #37-GP-9A.
- 2.7. Adhesive – Parafast or Millenium Adhesive supplied by Siplast.
- 2.8. Steel deck overlayment – 5/8" (16mm) prime glass-faced gypsum roof board (Dens-Deck prime), supplied by Georgia-Pacific Corporation.
- 2.9. Vapour retarder and reinforcement - applicable to steel deck overlayment – Paradiene 20 TG, 2.32mm modified membrane conforming to CGSB 37-G-56M supplied by Siplast.
- 2.10. Vapour retarder and reinforcement - applicable to cementitious deck - Paradiene 20 TG, 2.32mm modified membrane conforming to CGSB 37-G-56M supplied by Siplast.
- 2.11. Roof Board Insulation – **Min. R-35** three layers bi-directional (no joints to line up, to be staggered) Paratherm closed cell polyisocyanurate roof insulation integrally laminated to organic/inorganic facers in conformance with Environment

Canada Ozone-Depleting Substance regulations and conforming to CAN/ULC S704/ S770 Type II, Class 1 Grade 2 with 1/4" Protectoboard supplied by Siplast. *There will be no extra monies allotted for the wrong insulation thickness carried / provided by the roof bidder / Contractor.*

- 2.12. Tapered insulation – 2% polyisocyanurate insulation sloped to achieve positive drainage supplied by Siplast or Accu-Plane Enterprises.
- 2.13. Roof membrane composition - modified bituminous base sheet membrane 2.32mm Paradiene 20 TG EG surfaced with a modified cap sheet membrane 3.94mm Paradiene 30 TG Bright White (BW) with publish SRI 90 granular cap supplied by Siplast.
- 2.14. Membrane Flashings - modified bituminous base sheet membrane 2.32mm Paradiene 20 SA surfaced with a modified cap sheet membrane 4.14mm Parafor 30 TG (BW) with published SRI 90 granular cap supplied by Siplast. Colour to be selected by Owner and Consultant from manufacturer's full range of colours.
- 2.15. Waterproofing Underlayment – Paradiene 20 SA 98mls (2.55mm) thickness 3.28ft (1.00m) 33.5ft (10.21m) length self-adhesive modified bitumen membrane consisting of light weight random fibrous glass mat impregnated and coated with high quality styrene butadiene-styrene (SBS) modified bitumen with TA 325 self adhesive primer . Supplied by Siplast.
- 2.16. Cant strips - 3" x 3" (75mm x 75mm) torch safe cant strips supplied by Siplast.
- 2.17. Stack Jacks (pipe flashing) - SJ-41A 12" in height pre-insulated aluminum "stack jacks" supplied by Thaler Metal Industries Inc.
- 2.18. Miscellaneous Flashings (for protrusions through roof) – Provide ChemLink . Para Pro 123 Flashing System as supplied by Siplast
- 2.19. Gasline and other pipe supports as specified by Division 15 – Mechanical.
- 2.20. Sheet Metal for Flashing - 26 ga. pre-painted galvanized steel series 8000 supplied by Stelco - colour to be selected by Owner and Consultant prior to prefabrication from manufacturer's full range of colours.
- 2.21. Miscellaneous Metal for Flashing - for "hook-on" strips, fastening strips, metal bellows, etc., same metal as specified for sheet metal flashing but thickness shall be 1 ga. thicker.
- 2.22. Back paint for metal - asphalt primer (two coats) conforming to C.G.S.B. specification #37-GP-9.
- 2.23. Nails, bolts, screws and other fastenings - compatible with metal specified. Size of fasteners and type shall suit applicable conditions and must be approved by Owner or his authorized representative prior to use.
- 2.24. Roof drains – specified by Division 15 – Mechanical.

- 2.25. Plastic cement – PA-1021 plastic conforming to ASTM D 4586 Type II forasbestos free, asphalt base roof cement supplied by Siplast.
- 2.26. Caulking Sealant – PS 209 elastomeric sealant colour gray meeting CAN-19-13M82. Supplied by Siplast.

3. EXECUTION

3.1. PREPARATION

- 3.1.1. Remove all dust, dirt and debris from substrate and ensure same is smooth and free of all foreign matter. Perform only as much roof that can be completed each day or before showers commence. Take whatever action is necessary to prevent moisture from entering during roofing installations. Vacuum roof deck surfaces if necessary.
- 3.1.2. Inspect roof deck to determine if additional work is required before proceeding.
- 3.1.3. Any sharp projections, that in the opinion of the Consultant may penetrate the vapour retarder, shall be grounded smooth and flush.

3.2. ASPHALT PRIMING

- 3.2.1. Apply primer at the rate of 1 gal. (4.5L) per 100 sq. ft. (9m²) by brush or spray method. Work primer into surface by brooming and allow sufficient time for primer to penetrate and ensure same does not run into the building or stain aesthetic surfaces. Limit quantity of primer at deck openings and at points of termination to prevent damage to the building's interior.
- 3.2.2. Apply primer to vertical surfaces commencing at the top of cant strips and terminate primer 1" (25mm) below reglets and/or highest possible point.
- 3.2.3. Apply asphalt primer over all cementitious decks.

3.3. DECK OVERLAYMENT

- 3.3.1. Apply adhesive to the deck in ribbon form by mechanical means at the recommend rate. Immediately place dens-deck with the long sides at right angles to the run of the deck. All joints must be staggered and no pieces less than 1/3 of the full size sheet will be accepted. Apply vapour retarder over the surface of the dens-deck. Conform to "rated system" requirements.

3.4. VAPOUR RETARDER

- 3.4.1. Apply vapour retarder in straight lines, smooth, free from air pockets, wrinkles, fishmouths, open laps or tears, etc. Reinforce and extend vapour retarder minimum 12" (300mm) at perimeter, vertical walls, pipes and other

abutments. Continuously secure and laminate reinforcement to vapour retarder. Envelope insulation with vapour retarder and reinforcement by minimum 6" (150mm), all continuously secured to insulation.

3.5. ROOF BOARD INSULATION

- 3.5.1. Place Paratherm polyisocyanurate roof insulation with all joints staggered over the vapour retarder membrane with the longest side parallel to the perimeter where work is commencing. Where cutting and fitting is required, minimum width of insulation must be 12" (300mm). Do not force insulation into place. Cut neatly at protrusions and points of termination. Replace all broken, damaged or misfit boards as work progresses. Protect insulation from moisture during all phases of the application progresses. Paratherm is to be set in Parafast by Siplast a highly elastomeric, two components, one step, all purpose, foamable adhesive that contains no solvents and sets in minutes. Apply adhesive to vapour retarder with specified adhesive applied in 2 cm. wide bands every 33 cm using the manufacturer's recommended applicator. Protect insulation from moisture during all phase of application process. Remove any temporary waterproof cut off prior to continuing with further work.
- 3.5.2. Subsequent layers of Paratherm polyisocyanurate insulation shall be applied with specified adhesives at the same application rate and bead spacing as the previous layer. Ensure all layers of Paratherm polyisocyanurate roof insulation are offset at joints of each layer by minimum 12" (300mm). Tapered polyisocyanurate insulation is to be positioned on top of the flat stock polyisocyanurate and below the cover board.
- 3.5.3. Tapered insulation shall be installed on top of the polyisocyanurate insulation prior to installing the insulation cover board. Tapered insulation to be set Parafast adhesive and at the same bead spacing and application rate as previous layer.
- 3.5.4. Reduce insulation thickness by 1/2" (12.5mm) at all drainage locations for a distance of 36" (900mm) from the centre of the drain opening and an additional 1/2" (12.5mm) for a distance of 12" (300mm) from the centre of the roof drain opening. Totally fill flutes of steel decks with insulation at drain openings to provide continuous support for drain.

3.6. INSULATION COVER BOARD

- 3.6.1. Cover board shall be installed with specified adhesives at the same application rate and bead spacing as the previous layer(s) of insulation. Ensure cover board is offset at joints by minimum 12" (300mm). Walk cover-board in to place to ensure good contact.

3.7. INSTALLATION CANT STRIPS

- 3.7.1. Apply a single continuous and uniform bead OF Parafast adhesive in 2 cm.

wide bands every 33 cm using the manufacturer's recommended applicator to the surface of the cover board and embed the cant strips in place.

3.8. ROOF MEMBRANE BASE SHEET

- 3.8.1. Initially apply base sheet over cover board terminating 2" (50mm) above top of cant strips. Membrane shall be torched into place. Side laps shall be minimum 3" (75mm) and end laps minimum 6" (150mm) all continuously torched into place.
- 3.8.2. Starting at low points of each roof area apply modified bituminous membrane base sheet torched into place.
- 3.8.3. Rolls must first be unrolled to align each course then rerolled before torching commences.
- 3.8.4. Base sheet membrane not to be left exposed longer than ten days before cap sheet is applied. It is recommended the cap sheet application be completed immediately after base sheet has been installed.
- 3.8.5. At the end of each working day all insulation and cover board must be covered with a minimum of base sheet membrane.

3.9. ROOF MEMBRANE BASE SHEET FLASHING

- 3.9.1. Extend base sheet from a point 4" (100mm) on the flat roof surface terminating at the highest possible points and at eaves, parapets, copings the flashing membrane shall extend across the top and down the fascia to a point 1/2" (12.5mm) above the lowest terminating point of metal flashing at fascia.
- 3.9.2. Width of base sheet 1m wide, with lengths to fit, are to be cut from across the width of the rolls and torched or self adhere into place with no voids and with all laps sealed and mitres neatly cut and well sealed.
- 3.9.3. At sloping roofs base sheet membrane is to terminate 3ft up the sloping roof.

3.10. ROOF MEMBRANE CAP SHEET

- 3.10.1. Over the surface of the base sheet place the 4mm cap sheet into place and simultaneously heat the surface of the base sheet and underside of cap sheet to a point where the bitumen flows at a sufficient temperature to form homogeneous mass consisting of the base and cap sheet. Slowly roll membrane into the continuous bead of hot melted bitumen overlaps of the cap sheet shall not coincide with the base membrane but be offset by minimum 12" (300mm). Side laps shall be 3" (75mm) (follow selvage edge lines and end laps shall be 6" (150mm). The cap sheet shall terminate at the base of all cant strips.

- 3.10.2. The rolls must first be unrolled to align each course and then rerolled prior to torching the membrane into place.
- 3.10.3. All end laps of adjacent sheets are to be degranulated before the cap sheet membrane sheets are bonded together.
- 3.10.4. Liquid modified bitumen must flow in front of the cap sheet as it is being rolled onto the base sheet to ensure proper and complete adhesion. A bead of bitumen must flow out at the side lap onto the adjacent surface to seal the side laps.
- 3.10.5. Bleed outs of bitumen onto adjacent surfaces must be covered with additional loose granules the same colour as the cap sheet.
- 3.10.6. All end laps are to be neatly cut, the underlying selvage edge corners mitred and the cap sheet is to be neatly cut and fitted around all openings, sleeves, drains and curbing.
- 3.10.7. Care is to be taken not to walk on the freshly applied cap sheet and any marring or damaging of the cap sheet surface must be repaired either with additional granules broadcast into melted bitumen or with an additional ply of cap sheet. Contractors shall have a wet sponge on site at all time when applying the cap sheet membrane.
- 3.10.8. If a piece of cap sheet for repair is needed then this piece is to be at least 18" long and is to extend from the side lap of the repaired sheet over to butt against the side lap of the adjacent cap sheet course (The selvage strip is to be removed from the piece of repair material).

3.11. ROOF CAP SHEET FLASHING MEMBRANE

- 3.11.1. Apply one ply 4mm granular cap sheet as previously specified extending from a point 6" (150mm) on the flat roof surface terminating at highest possible point and at eaves, parapets and copings the flashing membrane shall extend across the top and down the fascia to a point 1/2" (12.5mm) above the lowest terminating point of metal flashing at fascia.
- 3.11.2. Width of the cap sheet 1m wide with lengths to fit, are to be cut from across the width of the rolls and torched into place with no voids and with all laps sealed and mitres neatly cut and well sealed.
- 3.11.3. All laps at mitres at adjacent sheets and the underlying cap sheet membrane surfaces are to be degranulated before the cap sheet membrane is torched into place
- 3.11.4. At parapets with a metal upstand to terminate membrane flashings a bead of sealant is to be applied and covered with granular
- 3.11.5. Mechanical fastening at curbs shall consist of nailing at the top at 6"

(150mm) oc. Wherever reglets occur and at vertical surfaces apply a bead of Parafast(PS-304 Sealant) where membrane terminates and secure 1" (25mm) below with a continuous metal fastening strip at 12" (300mm) oc.

- 3.11.6. "Strip-in" flanges of "stack jacks" and other flashing flanges with the flashing membrane basically as previously specified. Ensure flanges are primed and set into (PA-828 Flashing Cement) a bed of hot asphalt set in over the base sheet. The prime membrane shall be torched to the flange all as specified and directed. Around the base of the stack jack provide Parafast adhesive (PS-304 Sealant) and granular to match the colour of the membrane.

3.12. EXPANSION JOINTS

- 3.12.1. Supply and install metal bellows and insert expansion joint filler of sufficient height to extend 3/4" (18.75mm) above the top of cant strips. Terminate roof membrane at the base of expansion joint filler and immediately install fibre cant strips.
- 3.12.2. Commencing with the base sheet membrane extending 4" (100mm) on top of the previously applied system and extending up and over the expansion joint extending 4" (100mm) onto the previously applied system on the opposite side of the expansion joint. Once the base sheet membrane has been completed the cap sheet shall be torched into place extending 6" (150mm) onto the previously applied system and extending up and over the expansion joint extending 6" (150mm) on the opposite side of the expansion joint. Prior to installing the membrane degranulate the previously installed membrane as required. Flashing system at the junction of eaves must extend up and over eave and be secured at lowest point. Referring to walls and parapets, membrane shall extend 8" (200mm) up vertical surface and be mechanically secured.

3.13. WALL EXPANSION JOINTS

- 3.13.1. Supply and install metal bellows and insert expansion joint filler of sufficient height to extend 1 1/2" (37.5mm) above the top of cant strip. Terminate roof membrane at base of expansion joint filler and install fibre cant strip.
- 3.13.2. Provide the base sheet membrane commencing 4" (100mm) onto previously applied system extending up and over the cant strip, insulation and extending 17" up the vertical wall. Commencing 6" onto the previously applied system torch the modified membrane cap sheet into place over top of the entire base sheet membrane and extending 18" up the vertical wall. Apply mastic sealant where membrane terminates and provide continuous metal fastening strip 1" (25mm) below termination of the membrane flashing.

3.14. ROOF DRAINS

- 3.14.1. Temporarily block drain pipe during installation and ensure insulation thickness has been reduced.

- 3.14.2. Copper drains shall be set into a bed of Mastic. Ensure flashing flange is primed and strip-in flange with base sheet and cap sheet membrane.
- 3.14.3. Referring to scupper drains, ensure that same are prefabricated, complete with gravel stop, and flanges are primed. Extend base membrane through the scupper opening and turn the membrane down the face. Set scupper into a bed of Mastic, secure and strip-in flanges with cap sheet membrane.

3.15. CAULKING

- 3.15.1. Apply caulking sealant into all reglets and at points deemed necessary by the Owner or his authorized representative following installation of metal flashing. Caulking sealant shall be applied in strict accordance with the manufacturer's literature. Ensure caulking is tooled to provide and even finish. Colour of caulking shall match sheet metal counter-flashings or other adjacent material confirmed by the Consultant.
- 3.15.2. Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- 3.15.3. Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair work.
- 3.15.4. 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.
- 3.15.5. Ensure joint surfaces are dry.
- 3.15.6. Prepare surfaces in accordance with manufacturer's directions.
- 3.15.7. Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- 3.15.8. Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.
- 3.15.9. Apply bond breaker tape where required to manufacturer's instructions.
- 3.15.10. Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.
- 3.15.11. Apply sealant in accordance with manufacturer's written instructions.
- 3.15.12. Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- 3.15.13. Apply sealant in continuous beads.

- 3.15.14. Apply sealant using gun with proper size nozzle.
- 3.15.15. Use sufficient pressure to fill voids and joints solid.
- 3.15.16. Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- 3.15.17. Tool exposed surfaces before skinning begins to give slightly concave shape.
- 3.15.18. Remove excess compound promptly as work progresses and upon completion.
- 3.15.19. Cure sealants in accordance with sealant manufacturer's instructions.
- 3.15.20. Do not cover up sealants until proper curing has taken place.

3.16. CLEANUP

- 3.16.1. Clean adjacent surfaces immediately and leave work neat and clean.
- 3.16.2. Remove excess and droppings, using recommended cleaners as work progresses.
- 3.16.3. Remove masking tape after initial set of sealant.

3.17. VENT AND OTHER PIPES PROTRUDING THROUGH DECK

- 3.17.1. Install stack jacks, etc., including all accessories, specified and supplied by Division 15 and / or Division 16. Ensure flanges are primed and set in a continuous bed of asphalt. "Strip-in" flanges with 3-ply flashing membrane. Extend first ply 6" (150mm), second ply 9" (225m) and the third ply 12" (300mm) beyond the flange.

END OF SECTION

PART 1 GENERAL

1. GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this Section and shall apply as if repeated here.

1.2 REFERENCES

1. ASTM A563/A563M-97 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip process.
2. ASTM A591/A591M-89 Specification for Steel Sheet, Electrolytic ZincCoated, for Light Coating Mass Applications.
3. ASTM A606-96 Specification for Steel Sheet and Strip, Hot-Rolled and ColdRolled, High Strength, Low Alloy, with Improved Atmospheric Corrosion Resistance.
4. ASTM A792/A792M-96 Specification for Steel Sheet, Aluminum-Zinc AlloyCoated by the Hot-Dip Process.
5. ASTM D523-89 (1991)el Specular Gloss.
6. ASTM D822-96 Recommended Practice for Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Exposure Apparatus.
7. CSA A123.3-M1979 Asphalt or Tar Saturated Roofing Felt.
8. CSA B111-1974Wire Nails, Spikes and Staples.
9. CAN/CGSB-37.5-M89 Cutback Asphalt Plastic Cement.
10. CAN/CGSB-51.32-M77 Sheathing, Membrane, Breather Type.
11. Canadian Roofing Contractors Association (CRCA).

1.3 SUBMITTALS

1. Submit shop drawings in accordance with Section 01300 - Submittals.
2. Submit duplicate 50 x 50 mm samples of each type of sheet metal material, colour and finish.
3. Submit manufacturer's full colour range for Architect's selection for all prefinished sheet metal.

PART 2 PRODUCTS

2.1 SHEET METAL MATERIALS

1. Zinc coated steel sheet: 24 ga. 0.6 mm core nominal thickness, commercial quality CS type (A) to ASTM A653/A653M, with Z275 designation zinc coating.

2. Aluminum-zinc alloy coated steel sheet: to CSSBI 201M-84 commercial quality, grade with AZ150 coating, regular spangle surface, 24 ga. 0.6 mm base metal thickness, not oiled.

2.2 PREFINISHED STEEL SHEET

1. Prefinished steel to CAN/CGSB 93.3-M91 with factory applied polyvinyl chloride. Class F1S.
2. Prefinished with 0.200 mm thick polyvinyl chloride paint on exposed side and 0.005 mm thick epoxy primer on concealed side.
3. Colours to match wall below. Confirm with Architect prior to ordering of material.
4. Specular gloss: 30 units +/- 5 in accordance with ASTM D523.
5. Coating thickness: not less than 200 micrometers.
6. Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
7. Outdoor exposure period 5000 hours.
8. Humidity resistance exposure period 5000 hours.

2.3 ACCESSORIES

1. Isolation coating: alkali resistant bituminous paint.
2. Plastic cement: to CAN/CGSB-37.5.
3. Underlay for metal flashing: dry sheathing to CAN/CGSB-51.32 asphalt laminated 3.6 to 4.5 kg kraft paper No. 15 perforated asphalt felt to CSA A123.3.
4. Sealants: 1 part acrylic, high molecular weight polymer flexible sealant Dymonic as manufactured by Tremco Ltd. in colours to match the 3 flashing colours.
5. Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness 0.8 mm.
6. Fasteners: of same material as sheet metal, to CSA B111, galvanized steel spiral thread, nailing disc, nails of length and thickness suitable for metal flashing application, minimum 25 mm into nailing substrate.
7. Washers: of same material as sheet metal, 1 mm thick with rubber packings.
8. Screws: o. 305 stainless steel, self-tapping hexagonal head, neoprene washer and lead expansion shield.
9. Wedges: high impact polypropylene or rolled lead, 24 mm x 76 mm, tapered 1.6 mm to 6.4 mm.

10. Joint Filler: extruded polyethelane, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, oversized 30 to 50%, CFC free.
11. Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

1. Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA as indicated to conform to CRCA 'FL' series details.
2. Fabricate aluminum flashings and other sheet aluminum work in accordance with Aluminum Association Aluminum Sheet Metal Work in Building Construction.
3. Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.
4. Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.
5. Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
6. Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

1. Form flashings, copings, parapet and curb flashings, openings for mechanical roof openings and fascia to profiles indicated of 24 ga. 0.6 mm thick prefinished steel .

2.6 REGLETS AND CAP FLASHINGS

1. Formed recessed reglets for roof flashings by Masonry Section 04200 – Unit Masonry.
2. Cap Flashings shall be to profiles indicated of 24ga (0.6mm) G90 galvanized Grade A prefinished sheet steel conforming to ASTM A525. Colour as selected by Architect from manufacturers full range. Allow up to 3 colours.

2.7 SCUPPERS

1. Form scuppers from 24 ga. 0.6 mm thick (4.88) kg/m² prefinished steel sheet metal.
2. Sizes and profiles as indicated.
3. Provide necessary fastenings.
4. Install sheet metal in accordance with CRCA FL5 detail to provide detail as shown on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

1. Install sheet metal work in accordance with CRCA FL series details, FL 1, 2, 5, 11, 12, 13, 14, 15, 23, 126, 17 and as detailed.
2. Use concealed fastenings except where approved before installation.
3. Provide underlay under sheet metal. Secure in place and lap joints 100 mm.
4. Counter flash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.
5. Lock end joints and caulk with sealant.
6. Install surface mounted reglets true and level, and caulk top of reglet with sealant at locations where concrete or masonry does not occur.
7. Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
8. Caulk flashing at reglet and cap flashing with sealant.
9. Install pans, where shown around items projecting through roof membrane.

3.2 SCUPPERS

1. Install scuppers as indicated on architectural drawings.

3.3 VENT STACK FLASHING

1. Vent stack flashing to be SJ-20 or SJ-26 pre-insulated spun aluminum with telescoping cap complete with stainless steel vandal proof cap by Thaler Metal Industries Inc. Coordinate with Mechanical drawings and specifications for sizes, number and locations. Coordinate with roofing specifications to avoid duplication.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

1. This specification covers labor, materials, equipment, and application necessary for, and incidental to, the complete and proper installation of intumescent fire protection for application to steel structures and supports in accordance with all applicable requirements of contract documents.
2. This specification shall be supplemented by the applicable requirements of building codes, insurance rating organizations and all other authorities having jurisdiction.
3. Provide only at any exposed steel members requiring fire resistance rating where such members cannot be protected by means of masonry, drywall or fire insulation spray.
4. Provide at steel lintels over openings in load bearing walls where the opening is greater than 2000mm.
5. Provide at steel lintels over openings in non-load bearing walls where the opening is greater than 3000mm.

1.2 SECTION INCLUDES

1. Intumescent fire protection material.
2. Top-coat protective decorative finish.

1.3 REFERENCES

1. Underwriters Laboratories Inc. (UL) Fire Resistance Directory.
2. ULC - List of Equipment and Materials Test Standards
3. UL 263 (ASTM E119) - Fire Tests of Building Construction and Materials
4. CAN/ULC-S101 - Standard Methods of Fire Endurance Tests of Building Construction and Materials.
5. ASTM E84 (UL723, CAN/ULC-S102) - Surface Burning Characteristics of Building Materials. Class A Rating Required; Flame Spread Maximum: 10 and Smoke Developed Maximum: 50.
6. ASTM D2240 – Durometer Hardness (Shore D Only). Minimum: 84 Shore D.
7. ASTM D2794 – Impact Resistance. Intrusion minimum: 26 inch-lb. (0.65 kg-m)
8. ASTM D4060 – Abrasion Resistance. Maximum 0.7411 grams/1000 cycles.

9. ASTM D4541 – Bond Strength. Minimum: 165 psi. (1138 k Pa.)
10. Steel Structures Painting Council (SSPC) Surface Preparation Standards.
11. Material manufacturer's current published information.
12. AWCI Technical Manual 12-B "Standard Practice for the Testing and Inspection of Field Applied Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide", Second Addition.

1.4 SYSTEM DESCRIPTION

1. The intumescent fire protection materials shall be applied at the required thickness to provide the UL fire resistive ratings.

1.5 SUBMITTALS

1. Manufacturer's Data: Submit manufacturer's specifications, including certification as may be required to show material compliance with contract documents, Section 01300 – Submittals.

1.6 QUALITY ASSURANCE

1. Manufacturer - Company specializing in manufacturing fire protection products.
2. The intumescent fire resistive material shall be manufactured under the Follow-Up Service program of UL or ULC and bear the UL and/or ULC label (mark).
3. Applicator - A firm with expertise in the installation of fire resistive or similar materials. This firm shall be licensed and approved by the fire resistive material supplier.
4. Product - The product shall be approved by the architect and applicable authorities having jurisdiction.

1.7 DELIVERY, STORAGE AND HANDLING

1. Deliver materials to the project in manufacturer's unopened packages, fully identified as to trade name, type and other identifying data. Packaged materials shall bear the appropriate labels, seals and UL label (mark) for fire resistive ratings and shall be stored at temperatures between 50° F (10° C) and 100° F (38° C), in a dry interior location away from direct sunlight. DO NOT FREEZE.

1.8 PROJECT / SITE CONDITIONS

1. When the temperature at the job site is less than 50° F (10° C) a minimum substrate and ambient temperature of 50° F (10° C) shall be maintained prior to, during and a minimum of 72 hours after application. If necessary, for job schedule, the General Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.

2. In enclosed areas, ventilation shall not be less than 4 complete air exchanges per hour.
3. Relative humidity shall not exceed 75% throughout the total period of application and drying for the intumescent fire resistive material and must not exceed 75% throughout the application and drying for the protective decorative top-coat.

1.9 SEQUENCING AND SCHEDULING

1. Applicator shall cooperate in the coordination and scheduling of fire protection work to avoid delays in job progress.
2. The installation of piping, ducts, conduit or other suspended equipment shall not commence until the application of the thin-film fire resistive material is complete in that area.

PART 2 PRODUCTS

2.1 COMPATIBLE METAL PRIMER

1. Primer shall be approved by manufacturer and applied in full accordance with the primer manufacturer's written instructions.

2.2 INTUMESCENT FIRE PROTECTION SYSTEM

1. The intumescent fire resistive material shall be CAFCO SprayFilm® - WB 2 (lintels & beams), or WB 3 (exposed columns) as supplied by Isolatek International or CAFCO Industries or approved equal by A/D Fire Protection Systems, or Carboline Coatings.
2. Intumescent fire resistive material shall be applied in accordance with drawings and/or specifications and shall have been tested in accordance with the procedures of UL 263 or ASTM E119 or CAN/ULCS101, and reported by Underwriters Laboratories, Inc. or Underwriters Laboratories of Canada only.

2.3 DECORATIVE TOP-COATING

1. Top-coat materials shall be as required for color-coding, aesthetics or additional surface protection, and approved by the thin-film fire resistive manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

1. All surfaces to receive thin-film fire resistive material shall be clean, dry and free of oil, grease, loose mill scale, dirt, dust or other materials which would impair bond of the thin-film fire resistive material to the surface. Any cleaning of the surfaces to receive fire resistive material shall be the responsibility of the General Contractor or steel erector, as outlined in the structural steel section.

2. Confirm compatibility of surfaces to receive thin-film fire resistive material. Steel surfaces shall be primed with a compatible primer recommended by the thin-film fire resistive material manufacturer.
3. Provide masking, drop cloths or other suitable coverings to prevent overspray onto surfaces not intended to be coated with intumescent coating.

3.2 APPLICATION

1. The thin-film fire resistive material shall be applied at the required dry film thickness per the appropriate UL Design No.
 1. for beams: WB2 - F908, F911
 2. for columns: WB3 - cUL X650, ULC Z619

3.3 MOCK UP

1. Before proceeding with the work, the applicator shall apply the thin-film fire resistive material to a section witnessed by the architect's or owner's representative. The application shall be subject to their approval and shall be used as a guide for texture and thickness of the finished work.

3.4 CLEAN UP AND REPAIR

1. Upon completion of installation, all excess material, overspray and debris shall be cleared and removed from the job site.
2. All patching of and repair to thin-film fire resistive material, due to damage by other trades, shall be performed under this section and paid for by the trade responsible for the damage. Patching shall be performed by applicators licensed or otherwise approved by material supplier.

3.5 INSPECTION AND TESTING

1. In addition to continuous Wet Film Thickness checks performed by applicator during application, the installed intumescent material shall be inspected by a qualified independent testing laboratory for thickness in accordance with the AWCI Technical Manual 12-B "Standard Practice For The Testing and Inspection Of Field Applied Thin-Film Intumescent Fire Resistive Materials; an Annotated Guide", Second Addition, before application of the top-coat.
2. The results of the above tests shall be made available to all parties at the completion of each area and approved prior to the application of topcoat.

END OF SECTION

1 **GENERAL**

1.1 Conform to Sections of Division 1 as applicable.

1.2 **RELATED SECTIONS**

1.2.1 Firestopping and smoke seals: Section 07 27 00, Penetration Firestopping.

1.2.2 Sealing and sealants between aluminium entrances members and between aluminium entrances and adjacent construction: Section 08 41 00, Aluminium Entrances and Screens.

1.2.3 Sealing of joints around sound attenuating gypsum board partitions: Section 09 29 00, Gypsum Board.

1.2.4 Sealing around perimeter of security doors, frames, fixtures, fitments within Rooms, 142 to 154.

1.2.5 Read other Sections of Specifications for extent of sealing specified in those Sections. Do all other sealing indicated, specified or required.

1.3 **QUALITY ASSURANCE**

1.3.1 **Qualifications:** Perform work of this Section by recognized and established sealant applicator having experience using skilled mechanics trained in use of sealing equipment and specified materials.

1.3.2 Submit proof of experience upon Consultant's request.

1.4 **DELIVERY, STORAGE AND HANDLING**

1.4.1 Deliver caulking and sealing materials to Site in original, unopened containers with manufacturer's labels and seals intact. Labels shall identify manufacturer's name, brand name of product, grade and type, application directions and shelf life or expiry date of product.

1.4.2 Handle and store materials in accordance with manufacturer's printed directions. Store flammable materials in safe, approved containers to eliminate fire hazards.

1.4.3 Do not use caulking and sealing materials that has been stored for period of time exceeding maximum recommended shelf life of materials

1.5 **PROJECT CONDITIONS**

1.5.1 **Environmental Requirements:** Do not apply any sealant under adverse weather conditions, when joints to be sealed are damp, wet or frozen or when at ambient temperatures below 5 deg C (40 deg F). Maintain minimum temperature of application during application and for 8 hours after application. Consult

manufacturer for specific instructions before proceeding and obtain Consultant's approval.

1.6 WARRANTY

1.6.1 Warrant work of this Section against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct to satisfaction of Consultant and at no expense to Owner, any defects or deficiencies which become apparent within warranty period. Defects include, but are not limited to cracking, crumbling, melting, shrinkage, sag, failure in adhesion, cohesion or reversion, air and moisture leakage, marbling or streaking due to improper mixing, discolouration due to dirt pick-up during curing and staining of adjacent materials.

2 PRODUCTS

2.1 MATERIALS

2.1.1 **Colours:** Selected by Consultant from manufacturer's standard range to match colour of predominant materials to which sealant is applied.

2.1.2 **Formulation:** non-bleeding, non-migrating, capable of supporting their own weight. Use self levelling type for horizontal surfaces and non-sag type at vertical and soffit applications. Use 1 manufacturer's product for each Type specified.

2.1.3 Sealant Type A

2.1.3.1 One component modified urethane base chemical curing conforming to CAN/CGSB-19.13-M, Class MCG-2-25-B-N, Acceptable Products

Sikaflex 1A

Sika Canada Inc.

Dymonic and or Vulkem 116

Tremco Limited.

OR

Multi-component modified urethane base chemical curing conforming
CAN/CGSB-19.24-M, Type 2, Class B,
Acceptable Products

Sikaflex 2C NS

Sika Canada Inc.

Dymeric 240

Tremco Limited.

2.1.4 Sealant Type B

2.1.4.1 One component, chemical curing, mildew resistant silicone conforming to CGSB-19GO22M,, containing non-toxic fungicidal agents,
Acceptable Products

DC786

Dow Corning Canada Limited,

Sanitary 1700

GE Silicones

Tremisil 200

Tremco Limited

2.1.5 Sealant Type C

- 2.1.5.1 One component, acrylic latex emulsion base, Interior Latex conforming to CAN/CGSB-19.17-M, Tremflex 834 by Tremco Limited.

OR

One component urethane conforming to CAN/CGSB-19.13-M, Class MC-2-25-B-N,
Acceptable Products

Sikaflex 1A
Dymonic

Sika Canada Inc.
Tremco Limited.

OR

Multi-component modified urethane base chemical curing conforming
CAN/CGSB-19.24-M, Type 2, Class B.

Acceptable Product

Sikaflex 2C NS
Dymeric

Sika Canada
Tremco Limited.

2.1.6 Sealant Type D

- 2.1.6.1 One component urethane conforming to CAN/CGSB-19.13-M, Class MC-2-25-B-N,

Acceptable Products

Sikaflex 1CSL or THC900
Vulkem 45

Sika Canada Inc
Tremco Limited.

OR

Multi-component chemical curing polyurethane base conforming to
CAN/CGSB-19.24-M, Type 1, Class B,

Acceptable Products

Sikaflex 2CSL or THC900
or RC-2 SL
THC900 and or Vulkem 245

Sika Canada Inc.
Tremco Limited..

- 2.1.7 **Security Sealant (around all edges of doors, frames, walls, ceilings exposed edges between cove and wall, lighting, gap around CCTV cameras, around wall anchoring plates of anti-ligature wall mount seat – refer to Section 12 50 00; or any accessible gap) at Rooms 142 through 154 inclusive.**

- 2.1.7.1 High strength, two component, pure epoxy anchoring adhesive, low-VOC and styrene-free, non-sag

Acceptable Products, Alternates must be approved by Police Service. Sika

AnchorFix-3001

Sika Canada Inc.

Quickrete High Strength Anchoring Epoxy

Quickrete

- 2.1.8 **Joint Backing:** preformed, compressible, resilient, non-waxing, non-extruding, non-staining strips of closed cell polyethylene or urethane foam. Sizes and shapes to suit various conditions, diameter 25% greater than joint width. Backing shall be compatible with sealant, primer and substrate.
- 2.1.9 **Bond Breaker Tape:** as recommended by sealant manufacturer.
- 2.1.10 **Joint Primer:** non-staining, suitable for substrate surfaces, compatible with joint forming materials and as recommended by sealant manufacturer.
- 2.1.11 **Cleaning material:** non-corrosive, non-staining, solvent type, xylol, methyl-ethyl-ketone (MEK), toluol, isopropyl alcohol (IPA) or as recommended by sealant manufacturer and acceptable to material or finish manufacturers for surfaces adjacent to sealed areas.

3 **EXECUTION**

3.1 **EXAMINATION**

- 3.1.1 Ensure joints are suitable to accept and receive sealants. Commencement of work implies acceptance of surfaces and conditions.
- 3.1.2 Do not apply sealant to masonry until mortar has cured.
- 3.1.3 Before any sealing work is commenced, test materials for indications of staining or poor adhesion.

3.2 **PREPARATION**

- 3.2.1 Ensure that all joint interfaces are clean.
- 3.2.2 Clean joints and spaces which are to be sealed and ensure they are dry and free of dust, loose mortar, oil, grease, oxidation, coatings, form release agents, sealers and other foreign material.
- 3.2.3 Clean porous surfaces such as concrete, masonry or stone by wire brushing, grinding or sandblasting as required to obtain clean and sound surfaces.
 - 3.2.3.1 Remove laitance by grinding or mechanical abrading.
 - 3.2.3.2 Remove oils by sandblast cleaning.
 - 3.2.3.3 Remove loose particles present or resulting from grinding, abrading or sandblast cleaning by thorough brushing.
- 3.2.4 Clean ferrous metals of rust, mill scale and foreign materials by wire brushing, grinding or sanding.
- 3.2.5 Wipe non-porous surfaces such as metal and glass to be sealed, except

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- pre-coated metals, with cellulose sponges or clean rags soaked with ethyl alcohol, ketone solvent, xylol or toluol and wipe dry with clean cloth. Where joints are to be sealed with silicone based sealants clean joint with methyl-ethyl-ketone (MEK) or xylol. Do not allow solvent to air-dry without wiping. Clean pre-coated metals with solutions or compounds which will not injure finish and which are compatible with joint primer and sealant. Check ferrous metal surfaces are painted before applying sealant.
- 3.2.6 Examine joint sizes and where depth of joint exceed required depth of sealant correct to achieve proper following width/depth ratio:
- 3.2.6.1 Maintain 2:1 width/depth ratio: minimum joint size shall be 6 mm (1/4") x 6 mm (1/4"), maximum depth of sealant to be 13 mm (1/2").
- 3.2.7 Install joint backing material to achieve correct and uniform joint profile.
- 3.2.8 Where joint design or depth of joint prevents use of joint backing material, apply bond breaker tape to prevent three-sided adhesion.
- 3.2.9 Do not stretch, twist, puncture or tear joint backing. Butt joint backing at intersections. Install bond breaker tape at back of joint where joint backing is not required or cannot be installed.
- 3.2.10 Where surfaces adjacent to joints are likely to become coated with sealant during application, mask them prior to priming and sealing.
- 3.2.11 Do not exceed shelf life and pot life of materials, and installation times, as stated by manufacturer's.
- 3.2.12 Be familiar with work life of sealant to be used. Do not mix multiple component materials until required for use.
- 3.2.13 Use materials as received from manufacturer, without additions, deletions and adulterations of materials.
- 3.2.14 Mix multiple component sealants and bulks sealants using mechanical mixer capable of mixing without mixing air into material, strictly in accordance with manufacturer's directions and recommendations. Continue mixing until material is homogeneously blended, uniform in colour and free from streaks of unmixed material. Install compound prior to start of hardening or curing cycle.
- 3.2.15 Seal joints in surfaces to be painted before surfaces are painted. Where surfaces to be sealed are prime painted in shop before sealing check to make sure prime paint is compatible with primer and sealant. If they are incompatible, inform Consultant and change primer and sealant to compatible types approved by Consultant.
- 3.2.16 Where irregular surface or sensitive joint border exists, apply masking tape at edge of joint to ensure joint neatness and protection.

3.3 APPLICATION

- 3.3.1 Apply sealant using hand operated guns or pressure equipment fitted with suitable nozzle size and equipment approved by sealant manufacturer. Apply in accordance with manufacturer's directions and recommendations.
- 3.3.2 Force sealant into joint and against sides of joints to obtain uniform adhesion. Use sufficient pressure to completely fill all voids in joint regardless of variation in joint widths and to proper joint depth as prepared. Ensure full firm contact with interfaces of joint. Superficial pointing with skin bead shall not be acceptable.
- 3.3.3 Finish face of compound to form smooth, uniform beads. At recesses in angular surfaces, finish compound with flat face, flush with face of materials at each side. At recesses in flush surfaces, finish compound with concave face flush with face of materials at each side.
- 3.3.4 Compound may be tooled, provided that such tooling does not damage seal or tear compound. Avoid pulling of sealant from sides.
- 3.3.5 Tool surfaces as soon as possible after sealant application or before any skin formation has occurred, particularly when using silicone sealants.
- 3.3.6 Joint surfaces shall be straight, neatly finished, free from ridges, wrinkles, sags, dirt, stains, air pockets and embedded foreign matter or other defacement and be uniform in colour, free from marbling and/or colour streaking due to improper mixing or use of out of shelf life products.
- 3.3.7 Solvent curing sealants shall not be used indoors.
- 3.3.8 Use 1 of sealants specified for each type in following locations. Ensure sealant chosen (from several specified under each type under "MATERIALS") for each location is recommended by manufacturer for use for conditions encountered.
- 3.3.9 Joint designation in preceding paragraphs and fact that Drawings do not show all locations to be sealed, does not limit responsibility of this Section to seal all locations except those indicated in other Sections of Work, required to create and ensure continuous enclosure.

3.4 REPAIR

- 3.4.1 Remove any compounds not complying with requirements specified herein. Exercise care in removal operations not to mar or damage finishes adjacent to joints. Repeat preparation, priming and installation of new material as specified to provide finished work complying with specified requirements, and acceptable to Consultant. Do such repair work at no extra cost to Owner.

3.5 CLEANING

- 3.5.1 Immediately clean adjacent surfaces which have been soiled and leave Work in neat, clean condition. Remove excess materials, compounds smears or other soiling resulting from application of sealants. Use recommended cleaners and solvents.

3.6 PROTECTION OF COMPLETED WORK

- 3.6.1 Provide approved, non-staining means of protection for completed joint sealant installations where required to protect work from mechanical, thermal, chemical and other damage by construction operations and traffic.
- 3.6.2 Maintain protection securely in place until completion of Work. Remove protection when so directed by Consultant.

End of Section.

1. GENERAL

- 1.1. Conform to Sections of Division 1 as applicable.

1.2. RELATED SECTIONS

- 1.2.1. Installation of steel door frames in masonry: Setting in place by Section 06 20 00, Finish Carpentry and Millwork, building in by Section 04 20 00, Masonry Procedures.
- 1.2.2. Caulking of door frames: Section 07 92 00, Joint Sealants.
- 1.2.3. Wood Doors: Section 08 14 00
- 1.2.4. Hardware supplied by Section 08 71 00, Finish Hardware, installed by Section 06 41 00, Finish Carpentry and Millwork.
- 1.2.5. Glass & Glazing:. Section 08 80 00 for Glazed doors and screens.
- 1.2.6. Finish painting: Section 09 91 00, Painting and Finishing.

1.3. REFERENCES

ASTM A 653/A653M-09	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM A568M-09	Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold Rolled, General Requirements for
CSA W59-03	Welded Steel Construction (Metal Arc Welding)
CAN4-S104-M80 (R1985)	Fire Tests of Door Assemblies
CAN4-S105-M85 (R1992)	Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104
NFPA 80-90	Fire Doors and Windows

1.4. SUBMITTALS

- 1.4.1. Submit shop drawings in accordance with Section 01 33 00 Submittals.
- 1.4.2. Indicate each type of frame, door, core, metal thicknesses and finishes, openings, glazed, fire ratings, location of exposed fasteners, hardware blanking, reinforcing, tapping and drilling arrangements. Show large scale frame sections and anchoring details. Submit door and frame schedule identifying each unit. Ensure each unit bears legible identifying mark corresponding to that listed in door and frame schedule.
- 1.4.3. Submit for Consultant's approval, sample of frame corner showing construction, workmanship and finish.

- 1.4.4. Submit in addition to fire label, certificate to substantiate design and construction of fire-rated screen assemblies, if required by Consultant or authorities having jurisdiction.

1.5. DELIVERY, STORAGE AND HANDLING

- 1.5.1. Protect doors and frames during shipping and storage.
- 1.5.2. Note damage incurred during shipping.
- 1.5.3. Make good immediately any damage done. Clean scratches and touch up with rust-inhibitive primer. Replace damaged work which cannot be repaired, restored or cleaned.
- 1.5.4. Store materials on wood sleepers in dry area and cover to protect from damage. Coordinate this requirement with Section 06 41 00, Finish Carpentry and Millwork installing doors.
- 1.5.5. Remove wrappings or coverings from doors upon delivery at Site. Store doors in vertical position, spaced by blocking to permit air circulation between them.

2. PRODUCTS

2.1. MATERIALS

- 2.1.1. Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:
Ambico Ltd.
Artek Door Limited
Baron Metal Industries
Daybar Industries Ltd.
Macotta Company of Canada Ltd.
Metal Door Hardware Ltd.
S.W. Fleming Ltd.
Stanley-Bumeda Ltd.
- 2.1.2. **Sheet Steel:** Commercial grade steel to ASTM A568M, Class 1, hot-dip galvanized to ASTM A 653/A653M-96-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, ZF 75 (A25), known commercially as "Colourbond", "Satincoat", or "Galvanneal".

2.2. STEEL CORE THICKNESS (MINIMUM)

	Metric	Gauge
	Thickness	
2.2.1. Door Frames (and Transom Frames):	1.519 mm	16
2.2.2. Side Light and Window Frame Assemblies:	1.519 mm	16
2.2.3. Doors (and Base & Upper Panels located in Screens):		

2.2.3.1.	Hollow Steel Construction		
	- Face Sheets	1.519 mm	16
	- Vertical Stiffeners	0.912 mm	20
2.2.3.2.	Honeycomb Core Construction		
	- Face sheet	1.519 mm	16
2.2.4.	Accessories (Doors and Frames)		
2.2.4.1.	Reinforcements		
	- Lock and Strike Reinforcements	1.519 mm	16
	- Hinge Reinforcements	3.416 mm	10
	- Flush Bolt Reinforcement	1.519 mm	16
	- Reinforcement for Surface Applied Hardware	1.214 mm	18
	- Concealed Door Closer or Holder Reinforcements	2.657 mm	12
	- Top and Bottom End Channels	1.214 mm	18
2.2.5.	Steel Top Caps:	0.912 mm	20
2.2.6.	Glass Trim (Screw Fixed or Snap-In Types):	0.912 mm	20
2.2.7.	Floor Anchors:	1.519 mm	16
2.2.8.	Jamb Spreaders:	0.912 mm	20
2.2.9.	Wall Anchors:		
	- Masonry T-strap Type	1.214 mm	18
	- Masonry Wire Type	4.0 mm dia.	-
	- Masonry Stirrup-strap Type 50 mm x 250 mm (2" x 10" min.)	1.519 mm	16
	- Steel/Wood Stud Type	0.912 mm	20
	- Steel/Wood Stud Tension and Associated Wall Type	0.912 mm	20
2.2.10.	Fire Rated Door and Frame Assemblies: Conform to CAN4-S104-M,CAN4-S105-M and NFPA 80		

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- 2.2.11. **Primer:** Rust inhibitive touch-up only.
 - 2.2.12. **Adhesives**
 - 2.2.12.1. Honeycomb Cores and Steel Components: Heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
 - 2.2.12.2. Polyurethane Cores for Insulated Doors: Heat resistant, epoxy resin based, low viscosity, contact cement.
 - 2.2.12.3. Lock-Seam Doors: Fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.
 - 2.2.13. **Door Silencers:** Single stud rubber/neoprene type.
 - 2.2.14. **Fasteners for Stops:** Cadmium plated steel, counter sunk flat or oval head sheet metal Phillips screws.
 - 2.2.15. **Wide angle Door Viewer, Door Type 'H':** Large aluminium door scope, black. 2-3/8" hole required.
 - 2.2.16. Exterior Steel Door Frame: TB Series Frame, 16 ga. paintable G90 hot dipped galvanized frame; as manufactured by Fleming Door Products or equal.
 - 2.3. **FABRICATION**
 - 2.3.1. Permit access by an approved inspection and testing company for purpose of inspecting at random doors under fabrication.
 - 2.3.2. **Welding:** CSA W59-M.
 - 2.3.2.1. Grind exposed welds smooth and flush. Fill open joints, seams and depressions with filler or by continuous brazing or welding. Grind smooth to true sharp arises and profiles, and sand down to smooth, true, uniform finish.
 - 2.3.3. **Hardware Requirements:** Blank, mortise, reinforce, drill and tap doors and frames to receive mortised templated hardware. Check hardware list for requirements.
 - 2.3.4. **Frames-General**
 - 2.3.4.1. Fabricate frames for doors, screens and borrowed lights to profiles indicated.
 - 2.3.4.2. Interior frames shall be 1.519 mm (16 ga) welded type construction.
 - 2.3.4.3. Exterior frames shall be TB Series Frames as manufactured by Fleming Door Products or equal. Thermally broken steel frame, 16 ga paintable G90 hot dipped galvanized steel.

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- 2.3.4.4. Reinforce frame as required for surface mounted hardware. For door frames wider than 1.5 mm (5'), reinforce door frame head and jamb and mullions at junction of head.
 - 2.3.4.5. Where frames occur in masonry provide strip strap, T-strap or wire type anchors. Where frames occur in gypsum board provide stud type anchors.
 - 2.3.4.6. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb. Provide 2 anchors for rebate opening heights up to and including 1.5 mm (5') and 1 additional anchor for each additional 760 mm (30") of height or fraction thereof, except as indicated below. For frames in previously placed concrete, masonry or structural steel provide anchors located not more than 150 mm (6") from top and bottom of each jamb and intermediate anchors at 660 mm (26") on centre maximum.
 - 2.3.4.7. Where floor finishes allow, fabricate frames to extend 38 mm (1-1/2") below finished floor level. Where frames are to terminate at finished floor level, provide plates for anchorage to slabs.
 - 2.3.4.8. Prepare each door opening for single stud door silencers: 3 for single door openings placed opposite hinges: 2 for double door openings approximately 150 mm (6") each side of centreline of head stop.
 - 2.3.4.9. Supply removable portion of stop and frame where required for overhead concealed door closers and properly connect to frame and prepare for attachment to closer prior to shipment.
 - 2.3.4.10. Factory apply touch-up primer to areas where zinc coating has been removed during fabrication.
 - 2.3.4.11. Install door anchor clips to gypsum board installers' directions for steel door frames in solid gypsum board partitions. Ensure clips are supplied by Section 09 29 00, Gypsum Board.
 - 2.3.4.12. Factory apply touch-up primer to areas where zinc coating has been removed during fabrication.
 - 2.3.4.13. Construct door frames of labelled fire doors as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by nationally recognized listing agency to individual manufacturers and tested in conformance with CAN4-S104-M. Ensure ratings for frames match doors as minimum requirement. Locate label on frame jamb on hinge side, so it is concealed when door is closed.
 - 2.3.4.14. Undercut 19 mm (3/4") for air intake at washrooms and other doors indicated on Door Schedule.
 - 2.3.4.15. Install grilles in doors as noted in Mechanical Drawings and Specifications.

2.3.5. Welded Type Frames

- 2.3.5.1. Mitre corners of frames. Cut frame mitres accurately and weld continuously on inside of frame.

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- 2.3.5.2. Protect mortise cut outs with mortar guard boxes. Omit for gypsum board applications.
 - 2.3.5.3. When required due to large size of frame product, fabricate and ship to Site in sections. Indicate joints for field assembly on shop drawings.
 - 2.3.5.4. Cope and weld butt joints of mullions, transom bars, centre rails and sills. Grind welded joints to smooth uniform finish.
 - 2.3.5.5. Attach floor anchors to inside of each jamb profile.
 - 2.3.5.6. Weld in 2 temporary jamb spreaders at each frame to maintain alignment during shipment.
 - 2.3.5.7. Form glazing stops into channels, minimum 16 mm (5/8") height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
 - 2.3.6. **Prime Painting:** Apply factory touch up primer at areas where zinc coating has been damaged during fabrication.
 - 2.3.7. **Doors-General**
 - 2.3.7.1. Fabricate doors to be swing type flush with 1 continuous face free from joints, tool markings and abrasions and with provisions for glass and/or louvre openings as indicated on Door Schedule and Drawings.
 - 2.3.7.2. Fabricate interior doors to be honeycomb construction or insulated where noted.
 - 2.3.7.3. Interior doors to be steel stiffened with lockseam construction where noted.
 - 2.3.7.4. Insulate exterior doors and frames & provide thermal breaks. Exterior doors and frames to be paintable, G90 hot dipped galvanized steel.**
 - 2.3.7.5. For honeycomb doors longitudinal edges shall have mechanically interlocked, tack welded 150 mm o.c. (6"), filled and sanded flush.
 - 2.3.7.6. Fabricate doors with top and bottom inverted recessed spot welded channels.
 - 2.3.7.7. Reinforce, blank, drill and tap doors for mortised, templated hardware, including wide angle door scope to be provided under this section.
 - 2.3.7.8. Reinforce doors for surface mounted hardware.
 - 2.3.7.9. Factory prepare holes 13 mm (1/2") diameter and larger. Factory prepare holes less than 13 mm (1/2") when required for function of device for knob, lever, cylinder, turnpieces or when these holes overlap function holes.
 - 2.3.7.10. Fabricate fire rated door assemblies as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by nationally recognized listing agency to individual manufacturer and tested in conformance with CAN4-S104-M. Provide labels for fire rated doors.

- 2.3.7.11. Fabricate fire rated doors where indicated in Door Schedule or Drawings, to meet required maximum temperature rise on unexposed side of door in accordance with OBC and ULC requirements.
- 2.3.7.12. Construct rail and stile doors in same manner as flush doors.
- 2.3.7.13. Construct panels to match doors.
- 2.3.7.14. Reinforce panels to prevent oil canning. Install panels with concealed fasteners and reinforce to accommodate hardware as required. Provide door top and rebated matching panel where no transom mullion occurs.

2.3.8. Doors: Honeycomb Core Construction

- 2.3.8.1. Fabricate each face sheet for interior door from 1.519 mm (16 ga) sheet steel and laminate under pressure to honeycomb core or temperature rise rated core.
 - 2.3.8.2. Reinforce, stiffen and sound deaden doors with core laminated to inside faces of panels. Core shall completely fill inside hollow of door.
- 2.3.9. **Prime Painting:** Apply factory touch up primer at areas where zinc coating has been damaged during fabrication.

3. EXECUTION

3.1. Installation

- 3.1.1. Supply steel doors & frames to Section 04 20 00 Masonry or 06 41 00, Finish Carpentry and Millwork for installation.
- 3.1.2. Install screens as may be required.
- 3.1.3. Fire-rated door, frame and screen products shall be installed in accordance with the terms of their listing, NFPA-80 or the local Authority having Jurisdiction

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable

1.2 RELATED SECTIONS

1.2.1 Installation of wood doors frames and hardware for wood studs: Section 06 41 00, Finish Carpentry and Millwork.

1.2.2 Setting in place of door frames for steel studs by Section 06 41 00, Finish Carpentry and Millwork and installation by Section 09 29 00, Gypsum Board.

1.2.3 Supply steel door frames: Section 08 11 00, Steel Doors and Frames and setting in place by Section 06 41 00, Finish Carpentry and Millwork and installed by Section 04 22 10, Masonry Procedures, Section 09 29 00, Gypsum Board.

1.2.4 Supply of hardware: Section 08 71 00, Finish Hardware installed by Section 06 41 00, Finish Carpentry and Millwork.

1.2.5 Glazing: Section 08 80 00, Glass and Glazing.

1.3 REFERENCES

AWMAC	Architectural Woodwork Manufacturers Association of Canada, latest edition
ANSI/WDMA I.S.-13	Interior Architectural Wood Flush Doors
ANSI A208-1-2009	Particleboard
ASTM D1037-12	Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
NFPA 80-2016	Standard for Fire Doors and Fire Windows
NFPA 252-2017	Standard Method of Fire Tests of Door Assemblies.
ASTM E90-09 (2016)	Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions And Elements
ASTM E413-16	Standard Classification for Rating Sound Insulation
CAN3-A172-M79(R1996)	High Pressure Paper Base, Decorative Laminates
Forest Stewardship Council (FSC)	FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship
Sustainable Forestry Initiative (SFI)	SFI-Latest Standard.

1.4 SUBMITTALS

1.4.1 Action and Informational Submittals

1.4.1.1 Submit documentation from the manufacturer in the Close Out submittals that conform to Building Product Disclosure and Optimization-Sourcing of Raw Materials for Documentation of product claims for compliant summary documents for building materials contributing toward credit or other CaGBC-approved program. Including, but not limited to:

- .1 FSC Mix, SFI certification for all wood products.
- .2 Post and Pre-Consumer recycled content.
- .3 Third-party verified corporate sustainability reports (CSR).
- .4 Extended producer responsibility
- .5 Low Emitting Materials

1.4.2 Shop Drawings

1.4.2.1 Submit shop drawings in accordance with Section 01 33 00 Submittals.

1.4.2.2 Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, identify cut outs for glazing and other openings.

1.4.2.3 Submit product data indicating door core materials and construction; and face type plastic laminate.

1.4.3 Samples

1.4.3.1 Submit plastic laminate pattern, colour and gloss.

1.5 REGULATORY REQUIREMENTS

1.5.1 Submit certification that acoustic rated door construction meets ASTM E90 and ASTM E413 classification as indicated on Drawings or Schedule.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Do not accept delivery to Site until work of wet trades is complete and moisture readings of surfaces in proposed storage area is less than 18%.

1.6.2 Accept doors at Site in individual protective packaging.

1.6.3 Store doors flat on level surface in dry, well ventilated area inside building.

1.6.4 Cover top of pile with waterproof covering but allow air circulation at sides. Use opaque covering where sunlight might bleach veneer.

1.7 WARRANTY

1.7.1 Warrant work of this Section against defects and deficiencies for period of **3 years**. Promptly correct defects and deficiencies which become apparent

during warranty period, to satisfaction of Consultant and at no expense to Owner. Defects include, but are not limited to, bubbling, delamination of faces, or edges, warp, twist bow exceeding 6 mm (1/4"), and telegraphing of core. "Correct" referred to herein includes installing hardware, finishing, hanging and fitting.

1.8 WASTE MANAGEMENT AND DISPOSAL

1.8.1 Dispose of plastic, corrugated cardboard, polystyrene, packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.8.2 Divert unused adhesive material from landfill to official hazardous material collections site.

1.8.3 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Door Schedule and Specifications.

2.1.2 Baillargeon Doors Inc. 8500 ME & AF45-MO or equal.

2.1.2.1 Acceptable Manufacturer's: Lambton Door, Five Lakes Manufacturing.

2.1.2.2 For Acoustic Wood Doors (where STC rating required): To be equal to AMBICO Acoustic Wood Doors.

2.2 MATERIALS

2.2.1 Conform to ANSI/WDMA I.S.-13 for wood flush doors and AWMAC for stile and rail doors, except as specified herein.

2.2.2 Supply wood doors from same manufacturer.

2.3 Door Construction

2.3.1 Particle Core for Intensive Use Interior Wood Door

2.3.1.1 Product: 8500-OO as manufactured by Baillargeon Wood Door Manufacturer. Lifetime Warranty. Complies with FPC-5/FPC-7 (AWI/AWMAC).

- a. Core: Solid particleboard. Density of 28-32 lbs per cubic foot. Complies with ANSI A208-1 standards (LD-1/LD-2). **Wood or Strawboard, must be FSC mix; Preconsumer recycled material or Product Specific Type III EPD
- b. Stiles: Hardwood or laminated strand lumber (LSL) or 1/8 inch (3 mm) thick veneer, longitudinally laminated by hot pressing with type 1 structural glue, as per ASTM D5456-93 (LVL), including a 7/8 inch (22 mm) piece of hardwood, for a total width of 1-3/16 inches (30 mm):

- c. ME: Matched with faces.
- d. VE: Covered with 1/32 inch (0.7938 mm) of wood veneer, matched with faces.
- e. Top and Bottom Rails: 1-3/16 inches (30 mm) low-density wood or SCL (manufacturer's choice LVL or LSL).
- f. Lock Block: Integrated.
- g. Glue: Type 1 - PVA Cross link (UFF) ** must be Low emitting material compliant, CARB compliant/NAUF

2.3.2 Fire-Resistant Composite, 45 min, Agrifibre Core

- 2.3.2.1 Product: AF 45 as manufactured by Baillargeon Wood Door Manufacturer. Lifetime Warranty. Fire Rating: 45 minutes, in compliance with NFPA 80. Maximum Dimensions: 4 feet by 10 feet (single), 8 feet by 8 feet (double). Stile bonded to core.
- a. Stiles (45 Minute Rated): Special construction compliant with W/H label requirements. High-density mineral and/or SCL and untreated hardwood (minimum of 1-7/16 inches (37 mm)). Bonded to core.
 - b. VE: Covered with 1/32 inch (0.7938 mm) of wood veneer, matched with faces.
 - c. Stiles (60 Minute Rated): Special construction compliant with W/H label requirements. High-density mineral and untreated hardwood (minimum of 1-3/8 inches (35 mm)). Bonded to core. VE: Covered with 1/32 inch (0.7938 mm) of wood veneer, matched with faces.
 - d. Top and Bottom Rails: Special construction compliant with W/H label requirements. Mineral or SCL, manufacturer's choice (minimum of 2 inches (51 mm)). Bonded to core.
 - e. Core: Low combustible Agrifiber. Density of 34-38 lbs per cubic foot. Neutral FSC (UFF).
 - h. Glue: Type 1 PVA cross link (UFF). ** must be Low emitting material compliant, CARB compliant/NAUF
 - f. Pressure Provision: Neutral pressure in accordance with UL 10B/ UBC 7-2.

2.4 Door Facing

- 2.4.1 Plastic Laminate Facing: General Purpose (1.6 mm (1/16")) colour: 82020-38 French Pear, Fine Velvet Finish as manufactured by Wilsonart. Submit samples to Architect for approval prior to ordering material.
- 2.4.2 Exposed Vertical Edges: Hardwood for stain finish to match laminate.

2.5 Adhesives

Type I: PVA Cross-link. ** must be Low emitting material compliant, CARB compliant/NAUF

2.6 Accessories

- 2.6.1 Vision Frames for Unrated Doors: Wood, birch/maple species to be stained same colour as door, mitre corners; prepared for tamper proof screws.

2.7 FABRICATION

2.7.1 General

- 2.7.1.1 Fabricate flush doors in accordance with ANSI/WDMA I.S.-13 and stile and rail doors in accordance with AWMAC except as specified herein.
- 2.7.1.2 Size doors for 1.6 mm (1/16") clearance of heads and jamb and 9 mm (3/8") at bottom.
- 2.7.1.3 Undercut 19 mm (3/4") for air intake at washrooms and other doors as indicated on Door Schedule.
- 2.7.1.4 Bevel vertical edges of single acting doors 3 mm in 50 mm (1/8" in 2") on lock side and 1.5 mm in 50 mm (1/16" in 2") on hinge side.
- 2.7.1.5 Radius vertical edges of double acting doors to 60 mm (2-3/8") radius.
- 2.7.1.6 Seal wood edges and edges of cut outs before units are placed in unheated storage areas at plant or shipped to Site.

2.7.2 Flush Doors

- 2.7.2.1 Fabricate doors using 5 ply hot press construction technology. Bond stiles and rails to core using Type I. Sand for uniform thickness. Laminate door facing, crossbanding and assembled core in hot press.
- 2.7.2.2 Thoroughly sand back face of plastic laminate face veneer to provide homogeneous bonding surface. Apply plastic laminate to both faces of doors using adhesive. Bond material under pressure in accordance with material manufacturer's printed specifications, to smooth surface, free from distortion, waves, ridges or core ghost lines.
- 2.7.2.3 Factory sand assembled door leaf.
- 2.7.2.4 Factory machine doors for finish hardware in accordance with hardware requirements and dimensions.
- 2.7.2.5 Factory cut glass light openings. Ensure openings are square with internal corners slightly rounded. Ensure portion between cutout and door edge is not less than 125 mm (5") wide at any point. Ensure cut out area is not greater than 40% of area of door face. Ensure cut out does not exceed half height of door.
- 2.7.2.6 Provide hardwood glass stops, finished to match face veneer, for vision panels in unrated doors. Prepare for paint finish.
- 2.7.2.7 Factory fit doors for frame opening dimensions identified on shop drawings.
- 2.7.2.8 Provide inner blocks at lock edge, top of door closer and bottom for hardware reinforcement.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Supply wood doors to Section 06 41 00, Finish Carpentry and Millwork for installation.

End of Section

1 GENERAL

- 1.1 Conform to Sections of Division 1 as applicable.
- 1.2 Scope of work includes the provision of new security doors, complete with vision panels & food pass assembly, access doors and frames.

1.3 Doors to be Shop Painted by Security Door Fabricator off site.

1.4 RELATED SECTIONS

1.4.1 Finish painting: Section 09 96 10, Interior Special Coating – Epoxy Paint.

- 1.4.2 Masonry: Section 04 22 00 Provide steel door frames to Masonry section for building in frames.

- 1.4.3 Security Hardware: Section 08 78 00

1.5 REFERENCES

ANSI Z97.1-1984 (R-1994)	Safety Performance Specifications and Methods of Test for Safety Glazing used in Buildings
ASTM A167-99	Standard Specifications and Methods of Test for Safety Glazing used in Buildings.
ASTM A1008/A1008M-02	Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability (replaced A366)
ASTM A370-02	Test Methods and Definition for Mechanical Testing of Steel Products
ASTM A1011/A1011M-02	Specification for Steel, Sheet and Strip, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability (replaced A569)
ASTM A627-95	Specification for Homogeneous Tool-Resisting Steel Bars for Security Applications
ASTM A629-88(R1994)	Specification for Tool-Resisting Steel Flat Bars and Shapes for Security Applications
ASTM A635-02	- Specifications for Steel Sheet, Zinc-coated (Galvanized) by Hot Dipped Process, Commercial Quality.
ASTM B117-02	Method of Salt Spray (Fog) Testing
ASTM D256 –02e1	Standard Test methods for Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D638-02a	- Standard Test Methods for Tensile Properties of Plastics
ASTM D 790-02	- Standard Test Methods for Flexural Properties

ASTM D 792-00	- of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1735-02	- Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1929(R2001)e1	- Practice of Testing Water Resistance of Coating Using Water Fog Application
ASTM E 2074-00	Standard Test Method for Ignition Method of Fire Tests of Door Assemblies Including Positive Pressure Testing of Side-Hinged and Positive Swinging Door Assemblies
ASTM F 1233-98	Standard Test Method for Security Glazing Materials and Systems
ASTM F-1450-97	Standard Test Methods for Hollow Metal Swing Door Assemblies for Detention Centre
ASTM F-1577-01	Standard Test Methods for Detention Locks for Swing Doors.
CAN/CGSB-1.40-97	Primer, Structural Steel, Oil Alkyd Type
CAN/CGSB-12.1-M90	Tempered or Laminated Safety Glass
CGSB 31-GP-105Ma	Zinc Phosphate Conversion Coatings for Paint Base
CAN/ULC S702-97	Thermal Insulation, Mineral Fibre, for Buildings
CAN/CSA-G40.20/G40.21M98	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
CSA W59-M89(r2001)	Welded Steel Construction (Metal Arc Welding)
CAN4-S104-M80 (R1985)	
NFPA 80	Fire Doors and Windows
NFPA 252-95	Standard Methods of Fire Tests of Door Assemblies

1.6 SUBMITTALS

1.6.1 Product Data

1.6.1.1 Submit manufacturer's product, fabrication and installation instructions to suit Project requirements including Site conditions. Provide instructions for installation into opening with frame bracing detail and frame tolerances.

1.6.1.2 Submit manufacturer's printed product information that includes physical properties and recommended installation and glazing procedures including edge engagement guidelines.

1.6.2 Shop Drawings

1.6.2.1 Submit shop drawings in accordance with Section 01 33 00 Submittals.

- 1.6.2.2 Show actual plans, elevations and sections of each type of unit, complete with materials, core thicknesses, finishes, connection and joints, methods of anchorage, number of anchors, supports, reinforcement and accessories.

1.6.3 Operation and Maintenance Data

- 1.6.3.1 Submit operating and maintenance data for all equipment supplied.

1.7 QUALITY ASSURANCE

1.7.1 Qualifications

- 1.7.1.1 If requested, manufacturers shall provide evidence of having personnel and plant and equipment capable of fabricating hollow metal security door and frame assemblies of type specified. Provide evidence of having qualified welders capable to weld material types, thicknesses and joint types typical for hollow metal doors and frames on this Project. Manufacturers shall have a minimum of 5 (five) years of experience of regularly and successfully providing types of security doors and frames required for this Project. Substantiate with list of representative Projects where security door and frames were installed including dates of Projection completion.

- 1.7.1.2 Work of this Section shall be by Steelgate Security Products Ltd. or Strongbar Industries Inc. or Kach Inc. or SWS Detention Group Inc. provided they meet all specified requirements.

1.7.2 Quality Control

- 1.7.2.1 Check and verify each frame opening for tolerances, check initial setting, masonry support and anchorage system around frame.

1.7.3 Test Reports

- 1.7.3.1 Submit Test Reports listed herein. Test Reports shall include details of test samples and details and if requested photographs of testing apparatus. Test samples shall be retained at manufacturer's facilities for possible review.

- 1.7.3.2 Tool Resistant Steel: Submit test reports from qualified independent testing laboratory showing that tool-resistant steel used as part of work of this Section conforms with ASTM A627 and A629.

- 1.7.3.3 Static Load Test: To measure integrity of door construction. Support 3'-0" x 7'-0" flush door without any preparations for hardware and place beams across door at quarter points and then place third beam perpendicular to and top of first sets of beams. Apply load as listed herein employing a calibrated hydraulic ram. Measure panel deflection at centre point on panel using dial indicator.

Door Face Thickness: 14 gauge (2.00 mm)
Static Load: 14, 000 lb (6400 kg)

Max Deflection: 0.58" (15 mm)

- 1.7.3.4 Rack Test: To measure deflection due to racking load (twisting attack). Clamp 3'-0" x 7'-0" flush door without any preparations for hardware and place beams across door at quarter points and then place third beam perpendicular to and top of first sets of beams. Apply load as listed herein employing a calibrated hydraulic ram. Measure panel deflection at centre point on panel using dial indicator.

Door Face Thickness: 14 gauge (2.00 mm)
Racking Load: 7,500 lb (3400 kg)
Max Deflection: 3.5" (89 mm)

- 1.7.3.5 Impact Test: To assess full functionability of door under repeated bashing blows anticipated under riot conditions. Mount door in vertical position with required security hardware, maintain door in closed and locked position through out test. Apply repeated blows when door is maintained in this position. Subject mounted door to 200 ft/lb blows, delivered from a pendulum mechanism utilizing 80 lb weight. Deliver blows at location within 6" of its lock and 6" from of hinges.

Door Face Thickness: 14 gauge (2.00 mm)
Number of Impacts
at lock area 400
Number of Impacts
at hinge area 450

After impact loading door shall be fully functional.

- 1.7.3.6 Bullet Resistance Test: Submit Test Reports and certificate from qualified independent testing laboratory confirming that a sample door, frame and hardware assembly have been tested for level 3 in accordance with UL Standard 752 for bullet resistance. Test Reports shall include complete description of test procedures and results; firearms and ammunition used shall be certified as being correct with respect to bullet caliber, weight, muzzle velocity, and muzzle energy.

1.7.4 **Regulatory Requirements**

- 1.7.4.1 Fire rated door assemblies including frame and hardware shall comply with NFPA 80 and shall be tested, listed and labeled in accordance with CAN4-S104-M and shall carry label for fire rating indicated on Door Schedule. Marking shall be ULC Master label on each door, ULC Component label on each frame.

1.8 **WARRANTY**

- 1.8.1 Warrant bullet-resistant security glazing against delamination and any other defects and deficiencies for period of 5 years in accordance with General Conditions of the Contract. Promptly make good any defects or deficiencies

which become apparent during warranty period, to satisfaction of Consultant and at no extra cost to Municipality. Such warranty shall include replacement of defective security glazing complete with installation at Municipality's convenience.

- 1.8.2 Further warrant that installation of bullet-resistant security glazing is in accordance with Specifications and GANA (formerly Flat Glass Marketing Association (FGMA) recommendations for security glazing; and that no compounds nor solvent thinners or cleaners have been used in connection with installation and cleaning of security glazing which are deemed by glazing manufacturer to be incompatible with or hazardous to security glazing and its laminations.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 **Steel:** CAN/CSA-G40.20-M and CAN/CSA-G40.21-M, Grade 300W.
- 2.1.2 **Hollow Structural Sections:** CAN/CSA-G40.20-M and CAN/CSA-G40.21-M, Grade 350W.
- 2.1.3 **Sheet Steel:** Cold or hot rolled, commercial quality stretcher levelled carbon steel sheet coated to requirements of ASTM A635 with minimum zinc coating designation of Z275 or uncoated, ASTM A366M of following minimum thickness in mm (inches).

	<u>(Gauge)</u>	<u>Coated (gsq)</u>	<u>Uncoated (msg)</u>
Door Frames	(10)	3.54 (0.1382)	3.5 (0.1345)
Door Faces	(14)	2.04 (0.0785)	2.0 (0.0747)
Top, Bottom and Side Channels	(12)	2.84 (0.1084)	2.8 (0.1046)
Horizontal Stiffeners	(12)	2.84 (0.1084)	2.8 (0.1046)
Vertical Core Reinforcement	(26)	0.49 (0.0217)	0.45 (0.0179)
Reinforcements for Hardware	Manufacturer's standard to suit design requirements.		

Hardware reinforcements for full mortise hinges and pivots, for surface applied security hinges, for hanger attachment on sliding doors, reinforcements for lock fronts, concealed and surface mounted holders, internal reinforcements for surface applied hardware,

Glazing Stops Permanent or removable to suit design and as indicated on Drawings.

Permanent glazing may have moulding welded to both face sheets ready to secure glazing while removable glazing stop may be pressed steel angle or surface mounted glazing stop secured in place with tamper proof screws .

2.1.4 **Welding Materials:** CSA W59-M.

2.1.5 **Door Fill:** Mineral wool, CSA A101-M or rigid fibreglass, minimum density 96 kg/m³ (6 lb/cu ft).

2.1.6 **Phosphatizing:** CGSB 31-GP-105Ma.

2.1.7 **Prime Paint:** CAN/CGSB-1.40-M.

2.1.8 **Metal Filler:** Polyester based filler.

2.1.9 **Fastening Devices**

2.1.9.1 Exposed screws, bolts and nuts shall be security type. Fasteners in areas where not required to be removed and those on prisoner side of any construction, shall be either flat or round head, having extra head which will twist off when fully secured, leaving main head flush or projected without slots.

2.1.9.2 In areas where it is necessary to remove items, screws shall have slots or holes that require special security tool for their removal and shall be such that standard tools will not fit.

2.1.9.3 Expansion shields for setting in concrete shall be by recognized manufacturer. Each type of fastener shall be clearly indicated on shop drawings.

2.1.10 **Reinforcements and Anchor Systems**

2.1.10.1 Minimum thicknesses of hardware reinforcing plates shall be as follows:

Hinge and pivot reinforcements	5 mm x 38 mm 250 mm (3/16" x 1 1/2" x 10") long
Strike reinforcements	5 mm (3/16")
Closer reinforcements	5 mm (3/16")
Flushbolt reinforcements	5 mm (3/16")

2.1.10.2 For electrically operated hardware provide hardware enclosure and junction box interconnected using ULC approved conduits and connectors. Provide

access plates of same gauge as frame and fastened with temper resistant machine screws to facilitate installation of electrical wiring.

- 2.1.10.3 Floor Anchors: Provide floor anchors of same gauge as frame with minimum 2 holes for fastening to floors and spot welded to inside jamb. Provide adjustable floor anchors where required to suit design requirements.
- 2.1.10.4 Expansion Bolt Type Anchors for Masonry and/or Concrete Walls: Prepare frames with countersunk hole for a 1/2" diameter bolt with welded spacer on unexposed surface of frame to wall. Countersunk holes and welded spaces shall be spaced as specified herein above. After tightening of bolt sufficiently, weld bolt head to provide non-removable condition, grind, dress and finish smooth welded head bolt.
- 2.1.11 **Viewing Window with Bullet Resistant Glass**
- 2.1.11.1 Minimum 32 mm (1-1/4") thick, laminated glass, composed of multiple plies of clear plate or float glass, sandwiched with interlayers of high tensile strength poly-vinyl butyl.
- 2.1.11.2 Glass shall conform to CAN/CGSB-12.1-M and shall be Type 1, Laminated Glass made from Class B, Plate or Float Glass. Bullet resistant glass shall be tested and meet requirements of UL No. 752, Level 1. Each lite of glass shall be clearly marked bearing UL 752 stamp affixed to lower left corner.
- 2.1.11.3 Glass shall conform to CAN/CGSB-12.1-M and shall be Type 1, Laminated Glass made from Class B, Plate or Float Glass.
- 2.1.11.4 Following products are acceptable provided they meet above requirements:
- Lamiver Inc.
 - Tempa Glass Ind Ltd.
 - Tempglass Inc.
- 2.1.11.5 No deviations in finished laminated product shall result in objectionable visual distortion as determined by Consultant.
- 2.1.11.6 Provide proof, satisfactory to Consultant that bullet-resistant glass meets specified requirements.
- 2.1.11.7 Glazing Bedding Compounds and Tapes: Solvent-free, of type compatible with laminated glass. Solvent-free polysulphide, silicone or butyl rubber based sealants may be used.
- 2.1.11.8 Provide Stainless steel sliding cover for viewing window as per drawings.
- 2.1.12 **Food Pass/Cuff Port Assembly:** 262 Food Pass as manufactured by Southern Folger Detention Equipment or equal. Food Pass assembly shall have 1017A snap latch and two hinges - Type #203FP (Southern Steel).

- 2.1.13 **Secure Access Door: 590 hinged access door**, 10 ga door with 7 ga. Formed frame with full surface **sloped** top hinges, 214 S recessed door pull, with a Model 1010 deadlock by Southern Folger or equal.

2.2 **FABRICATION**

2.2.1 **General**

- 2.2.1.1 Metal shall be formed true to shop drawings, free from defects impairing strength, durability and appearance. Do not weld tool resisting bars.
- 2.2.1.2 Components shall be fabricated with required structural properties to safely withstand or abstain strain and stresses to which they will be subjected.
- 2.2.1.3 Steel plates shall be free from buckles and waves.
- 2.2.1.4 Fit and assemble work in shop where possible. Where shop fabrication is not possible make trial assembly in shop.
- 2.2.1.5 Supply anchoring devices required for fabrication and erection of this Section.
- 2.2.1.6 After fabrication remove mill scale, scrape and clean all ferrous metals and apply 1 coat of primer. Brush on and work well into crevices and interstices.

2.2.2 **Welding:** CSA W59-M.

- 2.2.2.1 Grind exposed welds smooth and flush. Fill open joints, seams and depressions with filler or by continuous brazing or welding. Grind smooth to true sharp arrises and profiles, and sand down to smooth, true, uniform finish.

- 2.2.3 **Hardware Requirements:** Blank, mortise, reinforce, drill and tap doors to suit frames to receive hinges, locksets and other hardware indicated on drawings. Verify keying requirements of the facility and Supply and Install under this section.

2.2.4 **Door Fabrication**

- 2.2.4.1 Fabricate door with face sheets both sides to overall thickness of 50.8 mm (2") or 57.2 mm (2-1/4"). Each face sheet shall be 1 piece construction formed to corner and meet at middle of door thickness with continuous weld on edges.

- 2.2.4.2 Reinforce core of door by 1 of following methods:

With fluted inner reinforcement extending full width and height of door. Reinforcement shall be of truss design with triangular form having flat apexes 70 mm (2-3/4") oc. Resistance weld faces to reinforcement at each apex across width of door and vertically at 75 mm (3") oc along full height of door.

OR

With reinforcing channels placed horizontally and continuously from side to

side as follows:

- Half way between horizontal centre line of door and top.
- Half way between horizontal centre line of door and bottom.
- Not more than 127 mm (5") above horizontal centre line of door.
- Not more than 127 mm (5") below horizontal centre line of door.
- Where any opening or accessory in door prevents horizontal reinforcing channel from being located as described above, provide 1 immediately above and below such opening.

2.2.4.3 Completely fill voids of core with specified filler.

2.2.4.4 Close edges of door with steel channels welded to both faces of door. Bevel lock side of stile 3 mm (1/8").

2.2.4.5 Weld continuous steel channels around observation port openings and around lock mounting boxes.

2.2.4.6 Provide glazing stops; weld inner stop in position and affix outer stop with twist off security screws.

2.2.4.7 Provide reinforcements to inside of door to receive security hinges.

2.2.5 Prime Painting

2.2.5.1 Steel surfaces shall be shop painted as follows:

- Wipe coat galvanized and prime painted **or**
- mill phosphatized and prime painted **or**
- shop degreased, phosphatized and prime painted.

3 EXECUTION

3.1 INSPECTION

3.1.1 Inspect surface and conditions to which work is to be attached and report any deficiencies.

3.1.2 Inspect frames prior to installation for size, swing, squareness, alignment, twist and plumbness. Tolerances shall not exceed following:

3.1.2.1 Squareness - 1.6 mm (1/16") measured on a line 90° from one jamb, at upper corner of frame at other jamb.

3.1.2.2 Alignment - 1.6 mm (1/16") measured on jamb on a horizontal line

parallel to plane of wall.

3.1.2.3 Twist - 1.6 mm (1/16") measured at face corners of jamb on parallel lines perpendicular to plane of wall.

3.1.2.4 Plumbness - 1.6 mm (1/16") measured on jamb at floor.

3.1.2.5 Prior to installation, check and correct frames to permissible installation tolerances.

3.2 **PREPARATION**

3.2.1 Take accurate field measurements of openings to receive work and make any required adjustments.

3.3 **INSTALLATION**

3.3.1 Erect work square, plumb, straight and true, accurately fitted, with tight joints and intersections.

3.3.2 Install doors in frames, adjust to close without binding. Joint width between door shall be 3 mm (1/8") maximum on each edge or as per hardware requirement.

3.3.3 Touch up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of installation.

3.3.4 Install bullet resistant glazing in work of this Section as scheduled. Conform to recommendation of Glazing Manual of GANA (formerly Flat Glass Marketing Association (FGMA), for security glazing work.

3.3.5 Do not use oil base or solvent compounds, nor solvent thinners or cleaners or any other detrimental product in connection with installation and cleaning of security glazing.

3.3.6 Finished installation shall be rigidly sitting in place and free of movement upon impact. Surfaces shall be smooth and free from abrasive or sharp corners.

3.3.7 Set, fit and adjust hardware according to manufacturer's directions as per shop drawings. Hardware shall operate freely. Wherever practicable, obtain and mount security hardware on work furnished by this Section prior to delivery to Site.

End of Section

Part 1 General

1.1 SECTION INCLUDES

- .1 Non-fire rated and Fire rated acoustic pressed steel frames.
- .2 Non-fire rated and Fire rated acoustic hollow metal doors.
- .3 Acoustic glass and glazing.
- .4 Perimeter and bottom acoustic seals, and threshold.
- .5 Factory finishing.

1.2 RELATED SECTIONS

- .1 Section 04 05 12: Masonry mortar fill of metal frames.
- .2 Section 09 29 00 - Acoustic Blanket Insulation: Insulation inside door frames, Gypsum Board
- .3 Section 07 92 00 - Joint Sealing: Caulking between doors and adjacent construction.
- .4 Section 08
- .5 Section 08 71 00 - Door Hardware-General.
- .6 Section 09 91 00 - Painting: Field painting of doors and frames.

1.3 REFERENCES

- .1 ASTM A653/A653M-15e1 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM E90-09(2016) - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 ASTM E413-16 - Classification for Rating Sound Insulation.
- .4 AWS D1.1/D1.1M:2015, Structural Welding Code - Steel.
- .5 CSA G40.20-13/G40.21-13 - General requirements for rolled or welded structural quality steel / Structural quality steel.
- .6 CSDMA, Selection and Usage Guide for Steel Doors and Frames, 2009.
- .7 ICC/ANSI A117.1-2003- Accessible and Usable Buildings and Facilities.
- .8 NFPA 80-16 - Standard for Fire Doors and Other Opening Protectives.

-
- .9 UL 10C-16 - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.4 REGULATORY REQUIREMENTS

- .1 Installed Door and Frame Assembly: Conform to NFPA 80 or UL 10C, for 90 min for fire rated class as indicated.
- .2 Conform to ICC/ANSI A117.1 for sound ratings up to STC 50.

1.5 SUBMITTALS

- .1 Section 01 33 00: Submittals.
- .2 Product Data: Provide product data on door construction.
- .3 Shop Drawings: Indicate door and frame elevations, anchor types and spacing, closure methods, finishes location of cut-outs for hardware and cut outs for glazing.
- .4 Samples: Submit manufacturer's door finish samples, frame corners, and perimeter acoustic gaskets.
- .5 Test Data:
- .1 Submit test data indicating compliance with the Sound Transmission Class (STC) requirements. Include laboratory name, test report number, and date of test.
 - .2 Submit certification from test laboratory qualified under the National Voluntary Accreditation Program (NVLAP) of the U.S. Bureau of Standards.
 - .3 Installation Instructions: Submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Perform Work to requirements of CSDMA (Canadian Steel Door Manufacturers Association) standards.
- .2 Provide Products of this section from a single manufacturer, unless components are referenced specifically in other sections.
- .3 Manufacturer: Minimum 5 years documented experience manufacturing sound control door assemblies.
- .4 Pre-installation Meeting: Convene a pre-installation meeting 2 weeks before installation of acoustic door and frame assemblies. Require attendance from relevant subcontractors, consultants, and manufacturer's representative. Review installation and coordination with other work.

1.7 DELIVERY, STORAGE AND PROTECTION

- .1 Section 01 60 00: Transport, handle, store, and protect products.
- .2 Comply with HMMA 840, and manufacturer's written instructions.

- .3 Weld minimum two temporary jamb spreaders per frame prior to shipment.
- .4 Remove doors and frames from wrappings or coverings upon receipt on site and inspect for damage. Leave doors covered for protection until hung. Store in vertical position, spaced with blocking to permit air circulation between components. Stand doors on top end, to avoid damage to bottom end.
- .5 Store materials out of water and covered to protect from damage.
- .6 Clean and touch up scratches or disfigurement caused by shipping or handling with zinc-rich primer.

1.8 WARRANTY

- .1 Manufacturer's Limited Warranty: Five (5) years from date of supply, covering material and workmanship.

Part 2 Products

2.1 MANUFACTURERS

- .1 AMBICO Limited
1120 Cummings Avenue
Ottawa, Ontario, Canada K1J 7R8
Toll Free Phone 888-423-2224
Phone 613-746-4663
Toll Free Fax 800-465-8561
Fax 613-746-4721
- .2 Other Acceptable Manufacturers:
 - .1 Fleming Door Products.

2.2 PERFORMANCE REQUIREMENTS

- .1 Acoustic Performance: Minimum Sound Transmission Class (STC) as noted and tested to ASTM E90.

2.3 MATERIALS

- .1 Sheet Steel:
 - .1 Galvanized steel ASTM A653/A653M, ZF75 (A25), minimum 1.5 mm thick.
- .2 Reinforcement: Same material as sheet steel.
- .3 Glass: Type as tested to achieve STC and fire ratings and shall be factory installed.

2.4 FABRICATION

- .1 Manufacture doors and frames to STC rating of 45 and 50, measured in accordance with ASTM E90.
- .2 Steel Doors:
 - .1 Sheet steel faces, thickness, design, and core suitable to achieve specified STC performance.
 - .2 Acoustic core construction, longitudinal edges fully welded.
 - .3 Reinforce doors where surface-mounted hardware is required.
 - .4 Drill and tap for mortised, templated hardware.
 - .5 Top and Bottom Channels: Inverted, recessed, welded steel channels.
 - .6 Factory installed glazing.
- .3 Steel Frames:
 - .1 Sheet steel, metal thickness as required to maintain door STC and fire ratings, mitred corners, fully welded seams.
 - .2 Factory assemble and fully weld frames.
- .4 Install and adjust perimeter and bottom acoustic seals around frames and mullions.
- .5 Affix permanent nameplates to door and frame, indicating manufacturer's name, and STC rating.

2.5 FINISHES

- .1 Factory Door Finish: Factory applied zinc phosphate primer; apply touch up primer where Product has been welded and ground smooth.

2.6 ACCESSORIES

- .1 Hinges: Heavy duty butt type for and including STC 52, to Hardware Schedule
- .2 Glazing Stops: Formed galvanized steel channel, mitred corners; prepared for countersink style tamperproof screws.
- .3 Primer: Rust inhibitive zinc phosphate should be VOC compliant with local indoor air quality regulations.
- .4 Threshold: Smooth and flush, to provide a seal for door in closed position.
- .5 Acoustic seals: Provide perimeter and bottom seals, tested as part of the ASTM E90 assembly to meet the specified STC rating.

Part 3 Execution

3.1 INSTALLATION

- .1 Install components to manufacturer's written instructions.
- .2 Install steel doors and frames to CSDMA and HMMA 840 standards and in accordance with NFPA 80 and UL 10C, and local authority having jurisdiction.
- .3 Install factory supplied glazing to frames.
- .4 Utilize welders certified by Canadian Welding Bureau (CWB) for field welding.
- .5 Coordinate with masonry and gypsum board wall construction for anchor placement.
- .6 Set frames plumb, square, level at correct elevation in accordance with Section 05 50 00.
- .7 Allow for deflection to ensure that structural loads are not transmitted to frame.
- .8 Adjust operable parts for correct clearances and function.
- .9 Install and adjust perimeter and bottom acoustic seals.
- .10 Finish paint in accordance with Section 09 91 00.
- .11 Touch up painted finishes where damaged.

3.2 ERECTION TOLERANCES

- .1 Maximum deviation from square, alignment, twist and plumb: +/- 0.75 mm (1/32").

3.3 FIELD QUALITY CONTROL

- .1 Provide qualified manufacturer's representative to instruct installers on the proper installation and adjustment of door assemblies.
- .2 Provide manufacturer's representative to inspect door installation, and test minimum five (5) cycles of operation. Correct any deficient doors.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulated Sectional Overhead Doors.
- B. Electric Operators and Controls.
- C. Operating Hardware, tracks, and support.

1.2 RELATED SECTIONS

Section 01 33 00 - Submittals.

Section 05 50 00 – Miscellaneous Metals

Section 07 92 00 – Sealants

Section 09 91 00 – Painting and Finishing for Finish paint of OH Doors

1.3 REFERENCES

- A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Wiring Connections: Requirements for electrical characteristics.
 - 1. 115 volts, single phase, 60 Hz.
- B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5 SUBMITTALS

- A. Submit under provisions of Section 013000.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened labeled packaging until ready for installation.
- B. Protect materials from exposure to moisture until ready for installation.
- C. Store materials in a dry, ventilated weathertight location.

1.8 PROJECT CONDITIONS

- A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.9 WARRANTY

- A. Warranty: Manufacturer's limited door warranty for 10 year against delamination of polyurethane foam from steel face and all other components for 1 year.
- B. Warranty: Manufacturer's limited door and operators System warranty for 10 year against delamination of polyurethane foam from steel face and all other components for 3 years or 20,000 cycles, whichever comes first.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 50 00.

2.2 INSULATED SECTIONAL OVERHEAD DOORS

- A. Insulated Steel Sectional Overhead Doors: Model 592 Thermacore Insulated Steel Doors by Overhead Door Corporation. Units shall have the following characteristics:
 - 1. Dimensions: 13'-1" W x 10'-10" H. Verify.
 - 2. Door Assembly: Metal/foam/metal sandwich panel construction, with PVC thermal break and weather-tight ship-lap design meeting joints.
 - a. Panel Thickness: 2 inches (51 mm).
 - b. Exterior Surface: Ribbed, textured.
 - c. Exterior Steel: .015 inch (.38 mm), hot-dipped galvanized.
 - d. End Stiles: 16 gauge with thermal break.

- e. Spring Counterbalance: Sized to weight of the door, with a helically wound, oil tempered torsion spring mounted on a steel shaft; cable drum of diecast aluminum with high strength galvanized aircraft cable. Sized with a minimum 7 to 1 safety factor.
 - High cycle spring: 25,000 cycles.
- f. Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
- g. Thermal Values: Tested installed assembly U-factor of 0.10 Btu/hr/SF degrees F; calculated section R-value of 17.50.
- h. Air Infiltration: 0.08 cfm at 15 mph; 0.08 cfm at 25 mph.
- i. High-Usage Package: Provide with optional high-usage package.
- j. Partial Glazing of Steel Panels:
 - 1) 1/2 inch (12.5 mm) Obscure Insulated glazing.
- 3. Finish and Color:
 - a. Two coat baked-on polyester:
 - 1) Interior color, white.
 - b. Baked-on Trinar polyvinylidene fluoride high performance coating:
 - 1) Exterior color, white.
- 4. Wind Load Design: Design as calculated in accordance with applicable code as follows:
 - a. Design pressure of (0.47 kPa).
- 5. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
- 6. Lock:
 - a. Interior mounted slide lock with interlock switch for automatic operator.
 - b. Locking mechanism designed to maintain security for exterior while permitting break out when impacted from the inside.
- 7. Weatherstripping:
 - a. EPDM bulb-type strip at bottom section.
 - b. Flexible Jamb seals.
 - c. Flexible Header seal.
- 8. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
 - a. Size:
 - 1) 3 inch (76 mm).
 - b. Type:
 - 1) Low headroom.
- 9. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
 - a. Entrapment Protection: Required for momentary contact, includes radio control operation.
 - 1) Photoelectric sensors monitored to meet UL 325/2010.
 - b. Operator Controls:
 - 1) Push-button operated control stations with open, close, and stop buttons.
 - 2) Flush mounting.
 - 3) Interior location.
 - c. Special Operation:
 - 1) Vehicle detector operation.
 - 2) Card reader control. Tied into Hirsch Keypad. Coordinate with Security Subtrade.
 - 3) Photocell operation.
 - 4) Explosion and dust ignition proof control wiring.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until openings have been properly prepared.
- B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- C. Verify electric power is available and of correct characteristics.
- D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean adjacent surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.
- B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- C. Anchor assembly to wall construction and building framing without distortion or stress.
- D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- E. Fit and align door assembly including hardware.
- F. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.4 CLEANING AND ADJUSTING

- A. Adjust door assembly to smooth operation and in full contact with weatherstripping.
- B. Clean doors, frames, glass, and polycarbonate according to manufacturer's instructions.
- C. Remove temporary labels and visible markings. Do not remove polycarbonate care and maintenance label required to maintain warranty.

3.5 PROTECTION

- A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- B. Protect installed products until completion of project.

- C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 This section refers to aluminium framing for millwork and interior windows.

1.2 RELATED SECTIONS

1.2.1 Millwork – Counter: Section 06 41 00 Finish Carpentry and Millwork.

1.2.2 Sealants: Section 07 92 00

1.2. Glass and Glazing: Section 08 80 00

1.3 SUBMITTALS

1.3.1 Shop Drawings

1.3.1.1 Submit shop drawings in accordance with section 01 33 00 Submittals. Indicate construction, materials and finishes.

1.3.2 Maintenance Data and Operating Instructions

1.3.2.1 Upon completion of installation, supply to the Consultant five copies of instructions covering adjustments and other relevant maintenance data.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Work of this Section shall be executed by a firm having previous experience satisfactory to Consultant in the successful manufacture and installation of work of the type and quality shown and specified.

1.4.1.2 Submit proof of experience upon the request of the Consultant.

1.5 PROJECT CONDITIONS

1.5.1 Protection

1.5.1.1 Provide suitable means of protection to finished aluminum surfaces to prevent damage by mortar, plaster, jointing compound or similar deleterious substances and to prevent physical damage to finished surfaces.

2 Products

2.1 MATERIALS

2.1.1 Aluminum Extrusions: Aluminum Association alloy AA 6063-T5, free from scratches and surface blemishes.

2.1.2 Frames and Screens at Millwork: 1-3/4" x 4" (44.5 mm x 101.6 mm nominal) B-Tube 500, Extruded aluminum sections having a minimum wall thickness of 2.0mm (.090") (3/32") suitably reinforced to ensure proper rigidity.

2.1.3 Interior Vestibule Storefront: 1-3/4" x 4-1/2" (44.5 mm x 114.3 mm); FlushGlaze 800 Series with 1" glazing infill by Alumicor or equal. ;

2.1.3 Aluminum Sheet: Aluminum Association alloy AA 1100, free from all scratches and surface blemishes.

2.1.4 Steel Reinforcements: CSA-G40.20/G40.21-98-General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels, Grade 300 W.

2.1.5 Screws, Bolts, Nuts, Washers and Other Fastening Devices: Stainless steel with not less than 12% chromium content to prevent galvanic action, and of sufficient strength for the purpose. Exposed screws or pop rivets are not acceptable.

2.1.6 Zinc Chromate Primer: CAN/CGSB-1.40-M.

2.1.7 Bituminous Paint: CAN/CGSB-1.108-M, Type 2.

2.1.8 Finishes

2.1.8.1 Clear Anodized: Designated AA-A41 Class I (Aluminum Association, mechanical finish unspecified, medium matte etch, Architectural Class I, 0.4 to 0.7 mil (10 *um* to 18 *um*) coating in accordance with Aluminum Association finish standards.

2.1.9 Glass: Free from bubbles, waves, discolouration and other defects, and of the following types for the locations indicated on Drawings or noted on Door Schedule.

2.1.9.1 Safety Glass: CAN/CGSB-12.1-M, **10 mm thickness** as indicated on Drawings. Type shall be Type 2, tempered/laminated glass.

2.1.9.2 All glass shall conform to CAN/CGSB-12.1, CAN/CGSB-12.3, and CAN/CGSB-12.20 where appropriate.

2.1.10 Glazing: Glaze screen using vinyl or neoprene glazing splines in accordance

with manufacturer's standards.

- 2.1.11 **Sealants:** Multi-component, chemical curing, CAN/CGSB-19.24-M, Type 2, or 1 component type, chemical curing, CAN/CGSB-19.13-M. Colours selected by Consultant.

2.2 **FABRICATION**

2.2.1 **General**

- 2.2.1.1 Do all fitting and assembly in the factory.

- 2.2.1.2 Trial fit units in the shop if permanent shop assembly is not practical.

- 2.2.2 **Aluminum Screens:** Fit and assemble as far as possible in factory, and fabricate with:

- 2.2.2.1 Metal sections drilled, tapped, welded, holed or slotted as may be required for the proper installation and fixing of all components and accessories, and supplied complete with all necessary anchors, clips, bolts, screws, etc.

- 2.2.2.2 Members possessing sharply defined profiles, straight, square and true with surfaces in proper planes and exposed finished surfaces and edges smooth and free from defects.

- 2.2.2.3 Framing, bracing, reinforcing and anchors having structural properties adequate to safely sustain and withstand strains and stresses to which they will be subjected.

- 2.2.2.4 Provision for proper expansion and contraction.

2.2.2.5	Provide closure cap at framing at exposed ends at both sides of transaction tray. Refer to drawing for size and location of opening/gap.

- 2.2.2.6 Joints and intersections accurately formed and tightly fitted; units water and weather tight.

- 2.2.2.7 Regular sight lines.

- 2.2.2.8 Bolts tight and threads nicked to prevent loosening of nuts; bolting made as inconspicuous as possible.

- 2.2.2.9 Preparation for glazing as required.

3 **EXECUTION**

3.1 **PREPARATION**

- 3.1.1 Take field measurements from actual structure and verify prior to commencement of fabrication.

- 3.1.2 Concealed surfaces of aluminum which would otherwise come in direct contact with structural steel, concrete, masonry or plaster shall be given a heavy protective coating of bituminous paint or zinc chromate primer prior to installation.

3.2 INSTALLATION

- 3.2.1 Set frames and screens plumb and true in openings securely wedged and held in alignment during construction and provided with suitable and adequate anchorage to adjoining work. Install hardware.
- 3.2.2 After installation of frames and screens and prior to glazing, adjust doors to provide continuous contact with adjoining members.
- 3.2.3 Caulk joints between masonry or other adjacent material and frames and between frames, sills and other material. Use methods specified in Section 07 92 00, Sealants. Caulk inside and outside.

3.3 CLEANING

- 3.3.1 Immediately prior to final cleaning of glass and before handing over building to Owner, make good damage and disfigurement to this work, remove any protective coatings, stains and foreign matter from exposed exterior and interior surfaces of aluminum work supplied under this Section and leave in a uniform colour, and in first-class condition to Consultant's satisfaction.
- 3.3.2 Clean using soap and water, or water and approved solvents not injurious to aluminum, glass, glazing and sealant compounds. Do not use abrasives.

End of Section

1 GENERAL

1.0. Conform to Sections of Division 1 as applicable.

1.1 RELATED SECTIONS

1.1.1 Building in of anchors, ties and inserts: Section 04 20 00, Unit Masonry

1.1.2 Hardware Schedule.

1.2 REFERENCES

CAN/CGSB 69.35-M89/ ANSI/BMHA A156.19-1984	Power Assisted and Low Energy Powered Operated Doors
ASTM E330-02	Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference
CAN/CGSB-1.40-97	Primer, Structural Steel, Oil Alkyd Type
CAN/CGSB-12.1-M90	Tempered or Laminated Safety Glass
CAN/CGSB-12.3-M91	Flat, Clear, Float Glass
CAN/CGSB-12.8-M97	Insulating Glass Units
CAN/CGSB-12.11-M90	Wired Safety Glass
CAN/CGSB-12.12-M90	Plastic Safety Glazing
CAN/CGSB-19.13-M91	Sealing Compound, One-Component, Elastomeric, Chemical Curing
CAN/CGSB-19.24-M90	Multicomponent, Chemical-Curing Sealing Compound
CSA-G40.20/G40.21-98	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels

1.3 SUBMITTALS

1.3.1 Shop Drawings

1.3.1.1 Submit shop drawings in accordance with section 01 33 00 Administrative Requirements. Indicate construction, materials and finishes, **door prep for finish hardware – Supplier to refer to Hardware Schedule for full scope of hardware being provided for the entrance doors.**

1.3.2 Maintenance Data and Operating Instructions

1.3.2.1 Upon completion of installation, supply to the Consultant five copies of instructions covering adjustments and other relevant maintenance data.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Work of this Section shall be executed by a firm having previous experience satisfactory to Consultant in the successful manufacture and installation of work of the type and quality shown and specified.

1.4.1.2 Submit proof of experience upon the request of the Consultant.

1.5 **PROJECT CONDITIONS**

1.5.1 **Protection**

1.5.1.1 Provide suitable means of protection to finished aluminum surfaces to prevent damage by mortar, plaster, jointing compound or similar deleterious substances and to prevent physical damage to finished surfaces.

1.6 **WARRANTY**

1.6.1 Warrant work of this Section against defects and deficiencies for period of **2 years** in accordance with General Conditions of the Contract. Promptly make good defects and deficiencies which become apparent within warranty period to satisfaction of Consultant and at no expense to Owner. Defects shall include, but not be limited to, leaking, deformation of members, loss of seal in sealed glass units, breakage of glass caused by frame distortions and thermal forces and discolouration of finishes.

2 **Products**

2.1 **MATERIALS**

2.1.1 **Aluminum Extrusions:** Aluminum Association alloy AA 6063-T5, free from scratches and surface blemishes.

2.1.2 **Doors:** Fabricated from extrusions having a minimum wall thickness of 3.2 mm (0.125"), except that glazing mouldings shall not be less than 1.27 mm (.050") thick, welded construction, with the following dimensions:

Acceptable material:

- .1 Entrance Doors, 400A INS by Alumicor or equal.
- .2 Frames, refer to Curtain Wall section with door adaptor.

Door thickness: 44 mm (1-3/4")

Stile: 101.6 mm (4")

Bottom Rail: 177.8 mm (7")

Top Rail: 98.4 mm (3-7/8")

Insulated bottom infill panel and centre rail, where noted on drawings.

Acceptable Manufacturers: Kawneer, Alumicor.

2.1.3 **Frames and Screens:** Extruded aluminum sections having a minimum wall thickness of 2.4 mm (.092") (3/32") suitably reinforced to ensure proper rigidity. Cross-section dimensions of frames for doors and screens shall be as detailed on Drawings. Bottom rail and centre rail of side lights shall match width of bottom rail and centre rail of door. Use door adaptor on double glazed Curtain Wall Thermawall 2600 capped system for frames and screens.

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- 2.1.4 **Aluminum Sheet:** Aluminum Association alloy AA 1100, free from all scratches and surface blemishes.
- 2.1.5 **Steel Reinforcements:** CSA-G40.20/G40.21-98-General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels, Grade 300 W.
- 2.1.6 **Screws, Bolts, Nuts, Washers and Other Fastening Devices:** Stainless steel with not less than 12% chromium content to prevent galvanic action, and of sufficient strength for the purpose. Exposed screws or pop rivets are not acceptable.
- 2.1.7 **Zinc Chromate Primer:** CAN/CGSB-1.40-M.
- 2.1.8 **Bituminous Paint:** CAN/CGSB-1.108-M, Type 2.
- 2.1.9 **Finishes**
- 2.1.9.1 Clear Anodizing: Aluminum Association designation AA-C22A31 with a minimum coating thickness of 0.0102 mm (0.7 mil), Coating Class I. Kawneer #14
- 2.1.10 **Hardware**
- 2.1.10.1 Unless otherwise specified herein, prepare doors for all finishing hardware associated with aluminum doors including but not limited to floor and wall stops where required. Perform drilling necessary to install stops and other hardware items fixed to adjacent construction.
- 2.1.10.2 Refer to Hardware Schedule for full list of Hardware. Preparation for Hardware: Accurately prepare and reinforce with backing plates to ensure adequate strength, cutouts, recesses and mortising required for hardware. Take delivery of hardware from Section 08 71 00, Finish Hardware, in addition to finish hardware required to be supplied with the work of this Section to complete installation.
- 2.1.11 **Glass:** Free from bubbles, waves, discolouration and other defects, and of the following types for the locations indicated on Drawings or noted on Door Schedule.
- 2.1.11.1 **Insulating Glass:**
Insulating glass units, exterior doors and exterior glazed units : To CAN/CGSB-12.8, double glazed, hermetically sealed, argon filled insulating glass units with low conductance black stainless steel warm edge spacer. At interior vestibule door and screen provide single tempered glass units.
 .1 Outer lite: 6 mm clear float glass with high performance low-E coating on surface two AG 43 by Guardian Glass or equal
 .2 Inner lite: 6 mm clear float glass.
- 2.1.11.2 All glass shall conform to CAN/CGSB-12.1, CAN/CGSB-12.3, and CAN/CGSB-12.20 where appropriate.

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- 2.1.12 **Glazing:** Glaze entrances using vinyl or neoprene glazing splines in accordance with manufacturer's standards.
- 2.1.13 **Sealants:** Multi-component, chemical curing, CAN/CGSB-19.24-M, Type 2, or 1 component type, chemical curing, CAN/CGSB-19.13-M. Colours selected by Consultant.
- 2.1.14 **Weatherstripping:** manufacturer's standard
- 2.2 **FABRICATION**
- 2.2.1 **General**
- 2.2.1.1 Do all fitting and assembly in the factory.
- 2.2.1.2 Trial fit units in the shop if permanent shop assembly is not practical.
- 2.2.2 **Aluminum Entrances and Screens:** Fit and assemble as far as possible in factory, and fabricate with:
- 2.2.2.1 Metal sections drilled, tapped, welded, holed or slotted as may be required for the proper installation and fixing of all components and accessories, and supplied complete with all necessary anchors, clips, bolts, screws, etc.
- 2.2.2.2 Members possessing sharply defined profiles, straight, square and true with surfaces in proper planes and exposed finished surfaces and edges smooth and free from defects.
- 2.2.2.3 Framing, bracing, reinforcing and anchors having structural properties adequate to safely sustain and withstand strains and stresses to which they will be subjected.
- 2.2.2.4 Provision for proper expansion and contraction.
- 2.2.2.5 Joints and intersections accurately formed and tightly fitted; units water and weather tight.
- 2.2.2.6 Regular sight lines.
- 2.2.2.7 Bolts tight and threads nicked to prevent loosening of nuts; bolting made as inconspicuous as possible.
- 2.2.2.8 Preparation for glazing as required.
- 2.2.3 **Doors**
- 2.2.3.1 Accurately join and fit to flush hairline joints, corners of doors and weld along the concealed lines of contact.
- 2.2.3.2 Thoroughly penetrate material with weld to produce complete fusion of metal between stiles and rails. Mechanically joined corners or those developed by tie rods or superficial welding will not be permitted.

- 2.2.3.3 Use interlocking type glazing beads with no exposed screws.
- 2.2.3.4 Fit each door leaf with an adjusting mechanism located in top rail near lock stile, permitting minor clearance adjustments after installation.

2.2.4 **Welding**

- 2.2.4.1 Welding of component members shall not in any way mar surface appearance of the metal. Welded joints shall be made tight and in true planes, ground and sanded smooth, flush with surface of base metal.
- 2.2.4.2 Weld only concealed surfaces in order that pitting-discolouration, weld halo and other surface imperfections will not be visible after finishing.
- 2.2.4.3 Preparation for Hardware: Accurately prepare and reinforce with backing plates to ensure adequate strength, cutouts, recesses and mortising required for hardware. Take delivery of hardware from Section 08 71 00, Finish Hardware, in addition to finish hardware required to be supplied with the work of this Section to complete installation.

3 EXECUTION

3.1 PREPARATION

- 3.1.1 Take field measurements from actual structure and verify prior to commencement of fabrication.
- 3.1.2 Concealed surfaces of aluminum which would otherwise come in direct contact with structural steel, concrete, masonry or plaster shall be given a heavy protective coating of bituminous paint or zinc chromate primer prior to installation.

3.2 INSTALLATION

- 3.2.1 Set frames and screens plumb and true in openings securely wedged and held in alignment during construction and provided with suitable and adequate anchorage to adjoining work. Install hardware.
- 3.2.2 After installation of frames and screens and prior to glazing, adjust doors to provide continuous contact with adjoining members.
- 3.2.3 Caulk joints between masonry or other adjacent material and frames and between frames, sills and other material. Use methods specified in Section 07 92 00, Sealants. Caulk inside and outside.
- 3.2.4 Completed installation shall be of adequate strength to support operating doors, and normal wind loading without glass shaking or vibrating when doors are in use.

3.3 CLEANING

- 3.3.1 Immediately prior to final cleaning of glass and before handing over building to Owner, make good damage and disfigurement to this work, remove any protective coatings, stains and foreign matter from exposed exterior and interior surfaces of aluminum work supplied under this Section and leave in a uniform colour, and in first-class condition to Consultant's satisfaction.
- 3.3.2 Clean using soap and water, or water and approved solvents not injurious to aluminum, glass, glazing and sealant compounds. Do not use abrasives.

End of Section

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

- .1 Section 07 27 00 – Air/Vapour Barriers.
- .2 Section 07 62 00 - Metal Flashing and Trim: Flashings.
- .3 Section 07 84 00 – Firestopping: Firestopping insulation.
- .4 Section 07 92 00 - Joint Sealing.
- .5 Section 08 41 00 – Aluminum Entrances and Screens.
- .6 Section 08 80 00 – Glass & Glazing: Insulating glass units
- .7 Section 08 85 00 – Glazing Sealants

1.3 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.

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- .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 Canada Green Building Council (CaGBC).
 - .1 LEED® Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations including Addendum 2007.
 - .5 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.
 - .6 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-[M1991(R2003)], Welded Aluminum Construction.
 - .7 Environmental Choice Program (ECP)
 - .1 CCD-45-[1995], Sealants and Caulking Compounds.
 - .8 Underwriter's Laboratories of Canada (ULC)

- .1 CAN/ULC-S710.1 [2005], Standard for Thermal Insulation – Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Materials Standard for Thermal Insulation - Bead - Applied One Component Polyurethane Air Sealant Foam, Part 1: Materials.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver material in accordance with Section 01 33 00 - Submittals.
 - .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 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim junction between combination units elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes fasteners, and caulking. Indicate location of manufacturer's nameplates.
- .3 Packaging Waste Management:
 - .1 Separate and recycle waste packaging materials in accordance with Section 01 35 00 – Environmental Protection Requirements.
 - .2 Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Co-ordination: Co-ordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays.
- .2 Pre-installation Meeting: Convene pre-installation meeting after Award of Contract and one week prior to commencing work of this Section to verify project requirements, substrate conditions and coordination with other building sub-trades, and to review manufacturer's written installation instructions.
 - .1 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:
 - .1 Owner;
 - .2 Consultant;
 - .3 Glazing subcontractor;
 - .4 Manufacturer's Technical Representative.
 - .2 Ensure meeting agenda includes review of methods and procedures related to glazed aluminum curtain wall installation including co-ordination with related work.
 - .3 Record meeting proceedings including corrective measures and other actions required to ensure successful completion of work and distribute to each attendee within 1 week of meeting.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Contract Conditions and Section 01 33 00 – Submittals.
- .2 Product Data: Submit product data including manufacturer's literature for glazed aluminum curtain wall extruded members, panels, components and accessories, indicating compliance with specified requirements and material characteristics.
 - .1 Submit list on curtain wall 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 Shop Drawings: Submit drawings stamped and signed by Professional Engineer registered or licensed in Province of Ontario, Canada. Include on shop drawings:
 - .1 Curtain wall panel and component 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. Indicate location of manufacturer's nameplates.
 - .2 Include details of fasteners between interior and exterior extrusions ensuring no penetration of thermal break or thermal bridging.
- .4 Samples:
 - .1 Submit duplicate 300 x 300 mm (12 x 12 inches) sample sections showing prefinished aluminum surface, finish, colour and texture, and including section of infill panel.
 - .2 Submit duplicate 300 x 300 mm (12 x 12 inches) sample sections of insulating glass unit showing glazing materials and edge and corner details.
- .5 Thermal Performance: Submit verification that Insulating Glass Units used in curtain wall system meet RSI (R) values specified.

1.7 TEST REPORTS

- .1 Submit test reports showing compliance with specified performance characteristics and physical properties including air infiltration, water infiltration and structural performance.

1.8 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for windows for incorporation into manual specified in relation to Close Out Procedures.
- .2 Provide warranty for the work of this Section against defects of materials and workmanship for a period of 1 year following the date of substantial completion.

1.9 QUALIFICATIONS

- .1 Windows shall be installed, glazed and adjusted by personnel having a minimum 5 years proven experience and in accordance with the manufacturer's instructions and approved shop drawings. Completed installation must be approved by the material manufacturer.

Part 2 Products

2.1 DESCRIPTION

- .1 Thermally broken, vertical stick-built glazed aluminum curtain wall system of tubular aluminum sections with self supported, supplementary supported framing, shop fabricated, factory prefinished, vision glass, insulated metal spandrel panel, spandrel infill; related flashings, anchorage and attachment devices.
- .2 Ensure assembled system design permits re-glazing of individual glass and infill panels from exterior without requiring removal of structural mullions.

2.2 DESIGN CRITERIA

- .1 Design curtain wall to AAMA CW-DG-1.
 - .1 Design glazed aluminum curtain wall following rainscreen principles.
 - .2 Ensure horizontal members are sealed to vertical members to form individual compartments in accordance with rainscreen principles.
 - .3 Ventilate and pressure equalize air space outside exterior surface of insulation to exterior.
- .2 Design aluminum components to CAN/CSA S157.
- .3 Design and size curtain wall components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of wall using design pressure of 0.95 kPa (20 psf) to AAMA CW 11 [ASTM E330].
 - .1 Design curtain wall system for expansion and contraction caused by cycling temperature range of [95] degrees C over [12] hour period without causing detrimental effect to system components.
 - .2 Thermal expansion: Ensure curtain wall system can withstand temperature differential of 85 degrees C and is able to accommodate interior and exterior system expansion and contraction without damage to components or deterioration of seals.
 - .3 Design vertical expansion joints with baffled overlaps and compressed resilient air seal laid between mullion ends.
 - .4 Ensure system is designed to accommodate:
 - .1 Movement within curtain wall assembly.

- .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.
- .5 Thermal resistance:
 - .1 Spandrel areas: RSI 3.0 (R 16.8).
 - .2 Vision glass areas: Insulating Glass Unit RSI
- .6 Limit mullion deflection to [flexure limit of glass 19 mm (0.75 inches) L/200 maximum with full recovery of glazing materials.
- .7 Deadload prevention: Design curtain wall system with separate, integrated support for insulating glass units.
- .8 Sound attenuation through wall system (exterior to interior): STC 33 to [AAMA T1R - A1] [ASTM E413].
- .9 Glass dimensions: Size glass units to CAN/CGSB-12.20.
- .10 Flatness criteria: 6 mm (0.25]inches) maximum in 6 m (20 feet) for each panel.
- .11 Air infiltration: 0.3 L/s/m² (0.63 cfm) maximum of wall area to [AAMA 501] [ASTM E283] at differential pressure across assembly of [300] Pa (0.044 psi).
- .12 Water infiltration: None to [AAMA 501] [ASTM E331] [ASTM E1105] at differential pressure across assembly of [720] Pa (0.104 psi).
- .13 Ensure interior surfaces have no condensation before exposed edges of sealed units reach dew point temperatures during testing to AAMA 501.
- .14 Maintain continuous air barrier and vapour retarder throughout building envelope and curtain wall assembly.
- .15 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.

2.3 MATERIALS

- .1 Curtain Wall System and Components:
 - .1 Extruded aluminum: To ASTM B221, 6063 alloy with [T5] [T6] temper.
 - .1 Finish coatings: To AA DAF 45 Architectural Class I clear anodized 18 µm (0.0007 inches) thick minimum.
 - .2 Sheet aluminum: To ASTM B209, utility grade for unexposed surfaces.
 - .3 Air barrier liner: Reinforce panels to maintain flat surface.
 - .1 Concealed locations: 0.952 mm (20 gauge) steel sheet to CSA-S136M with 458 g/m² (1.25 oz/sq.ft) galvanized coating and corners sealed at concealed locations.

- .4 Fasteners, screws and bolts: Tamperproof, cadmium plated stainless steel 300 or 400 series to meet curtain wall requirements and as recommended by manufacturer.
- .5 Anchors: Ensure anchors have three-way adjustment.
- .6 Insulating glass units: To CAN/CGSB-12.8, double glazed, hermetically sealed, argon filled insulating glass units with low conductance black stainless steel warm edge spacer.
 - .1 Outer lite: 6 mm (0.25 inches) clear float glass with high performance low-E coating on surface two AG 43 by Guardian Glass or equal
 - .2 Inner lite: 6 mm (0.25 inches) clear float glass.
- .8 Aluminum panels: 3 mm (0.125 inches) thick factory formed panels.
 - .1 Finish after forming to match curtain wall system.
- .9 Thermal Break: Glass fibre reinforced polyamide porthole extrusion.
- .10 Curtain wall back pan insulation: 100 mm (4 inches) thick.
 - .1 Density: 64 kg/m³ (4 lbs/cu ft) minimum.
 - .2 Thermal resistance: RSI 3.0 (R 16.8) or better.
- .2 Acceptable Material: Alumicor Ltd., ThermaWall 2600 Series.

2.4 CURTAIN WALL SYSTEM FABRICATION

- .1 Do aluminum welding to CAN/CSA W59.2.
- .2 Fabricate aluminum assemblies of extruded sections to sizes and profiles indicated.
 - .1 Ensure vertical and horizontal members are tubular extrusions designed for shear block corner construction.
 - .2 Mullion depth sizes as indicated.
 - .3 Cap depth sizes: 19 mm (0.75 inches).
 - .4 Structural silicone joints where indicated.
 - .5 Ensure caps for mullion assemblies are constructed without gap.
- .3 Construct units square, plumb and free from distortion, waves, twists, buckles or other defects detrimental to performance or appearance.
 - .1 Ensure curtain wall is fabricated with separate, integrated support for insulating glass unit.
 - .2 Do glazing in accordance with Section 08 80 00 – Glazing.
 - .3 Site glazing is permitted.
- .2 Fabricate curtain wall with minimum clearances and shim spacing around panel perimeter and ensure installation and dynamic movement of perimeter seal is enabled.
- .3 Fabricate infill panels with metal covered edge seals around perimeter of panel assembly, enabling installation and minor movement of perimeter seal.
 - .1 Reinforce interior surface of exterior infill panel sheet from deflection caused by wind and suction loads.

- .2 Place insulation within infill panel adhered to exterior face of interior panel sheet over entire area of sheet using impale fasteners with integral discs.
- .3 Reinforce infill panels to receive brackets and attachments as indicated.
- .4 Accurately fit and secure joints and corners.
 - .1 Ensure joints are flush, hairline, and weatherproof.
- .5 Prepare curtain wall to receive anchor devices.
- .6 Use only concealed fasteners
 - .1 Ensure fasteners do not penetrate thermal break.
 - .2 Where fasteners cannot be concealed, countersunk screws finished to match adjacent material may be used upon receipt of written approval from Consultant.
- .7 Prepare components to receive doors and openings as indicated.
- .8 Reinforce head rail of interior components to receive track brackets and attachments for window blinds as indicated.
- .9 Visible manufacturer's labels are not permitted.

2.5 FINISHES

- .1 Exterior exposed aluminum surfaces: To AA DAF-45-M10C21A41, Architectural Class I, clear anodized 18 µm (0.0007 inches) minimum thickness
 - .1 Acceptable material: Alumicor Ltd., Class I Anodic Finish.
- .2 Interior exposed aluminum surfaces: To AA DAF-45-M10C21[A41][A44], Architectural Class I, anodized 18 µm (0.0007 inches) minimum thickness clear.
 - .1 Acceptable material: Alumicor Ltd., Class I Anodic Finish.

2.6 ACCESSORIES

- .1 Fibre board: to ASTM C612.
 - .1 Type: 1VB.
 - .2 Density: 64 kg/m³ (4 lbs per cu.ft.) minimum.
 - .3 Thickness: 100 mm (4 inches) minimum.
 - .4 Acceptable material: Roxul Inc., CurtainRock.
- .2 Gasketing: To zCCD-45] Silicone compatible rubber or extruded silicone gaskets.
- .3 Setting Blocks: To CCD-45 and ASTM D2240, silicone, 80-90 Shore A Durometer hardness.
- .4 Spacers: To CCD-45 and ASTM D2240, silicone, 50 - 60 Shore A Durometer hardness.

- .5 Sealant: To CAN/CGSB-19.13, Class 40, one-component, cold-applied, non-sagging silicone.
 - .1 Acceptable material: Dow Corning 795.
- .6 Sealant Bond Breaker: Open cell foam backer rod sized to suit project requirements.
- .7 Flashings: 3 mm (0.125 inches) thick aluminum flashing to profiles indicated and in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.
- .8 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.
- .9 Miscellaneous Components: Covers, copings, special flashings, filler pieces, termination pieces, cap closures, expansion joint covers, and metal bellows to match curtain wall system as indicated.

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 curtain wall 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 WINDOW INSTALLATION

- .1 Install curtain wall in accordance with manufacturer's written instructions.
- .2 Do aluminum welding to CAN/CSA W59.2.
- .3 Attach curtain wall assemblies to structure plumb and level, free from warp, and allow for sufficient adjustment to accommodate construction tolerances and other irregularities.
 - .1 Maintain dimensional tolerances and align with adjacent work.
 - .2 Use alignment attachments and shims to permanently fasten elements to building structure.
 - .3 Clean welded surfaces and apply protective primer to field welds and adjacent surfaces.

- .4 Install thermal isolation where components penetrate or disrupt building insulation.
- .5 Install sill flashings.
- .6 Co-ordinate installation of fire stop insulation, in accordance with Section 07 84 00 - Firestopping, at each floor slab edge and intersection with vertical construction where indicated.
- .7 Co-ordinate attachment and seal of perimeter air barrier in accordance with Section 07 27 00 – Air Barriers.
- .8 Install liquid foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- .9 Install insulating glass units and infill panels in accordance with Section 08 80 00 - Glazing and to manufacturer's written instructions.
- .10 Install perimeter sealant to method required to achieve performance criteria, backing materials, and installation criteria in accordance with Section 07 92 00 - Joint Sealing. Refer to Section 08 85 00 for Glazing Sealants.

3.3 FIELD QUALITY CONTROL

- .1 Field Inspection: Coordinate field inspection in accordance with Section 01 45 00 - Quality Requirements.
- .2 Site Installation Tolerances:
 - .1 Variation from plumb: 12 mm per 30 m (0.5 inches per 100 feet) maximum.
 - .2 Misalignment of two adjacent panels or members: 0.8 mm (0.03 inches) maximum.
 - .3 Sealant space between curtain wall and adjacent construction: 13 mm (0.5 inches) maximum.
- .3 Manufacturer's Services:
 - .1 Coordinate manufacturer's services with Section 01 45 00 - Quality Requirements.
 - .2 Submit to Consultant a written agreement from the manufacturer to perform the manufacturer's services.
 - .3 Schedule manufacturer's review of work procedures at stages listed:
 - 1. Product Application: 1 off site review.
 - 2. Fabrication and Handling: 1 review at authorized installers fabrication facilities.
 - 3. Installation: 3 site reviews at commencement of Work, 50% completion of Work, Upon completion of Work.

- .4 Submit manufacturer's written reports to Consultant describing:
 - .1 The scope of work requested.
 - .2 Date, time and location.
 - .3 Procedures performed.
 - .4 Observed or detected non-compliances or inconsistencies with manufacturers' recommended instructions.
 - .5 Limitations or disclaimers regarding the procedures performed.
 - .6 Obtain reports within seven days of review and submit immediately to Consultant.

3.4 CLEANING

- .1 Progress Cleaning: Perform cleanup as work progresses in accordance with Section 01 71 00 – Execution Requirements, 4.1.1 Progress Cleaning
 - .1 Leave work area clean end of each day.
- .2 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 71 00 – 4.2 Final Cleaning
- .3 Waste Management:
 - .1 Co-ordinate recycling of waste materials with 01 35 00 - Environmental Protection Requirements.
 - .2 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.
- .4 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 glazed aluminum curtain wall installation

END OF SECTION

1 GENERAL

- 1.1 Conform to Sections of Division 1 as applicable.
- 1.2 Supply of Finish Hardware to be part of the cash allowance.
- 1.3 Install of Finish Hardware to be included in base bid tender price.
- 1.4 A Finish hardware Schedule will be provided to the General Contractor upon award of contract for tendering to minimum three (3) bidders to be paid from cash allowance for supply only of finish hardware. See attached Hardware List.

1.2 RELATED SECTIONS

- 1.2.1 Installation of Abloy locking hardware and padlock hasps: Section 06 41 00, Carpentry and Millwork;
- 1.2.2 Supply and installation of hardware for toilet partitions: Section 10 21 00, Stainless Steel Toilet Partitions.
- 1.2.3 Installation of hardware for aluminum entrance doors are outlined in Section 08 41 10, Aluminum Entrances and Screens. All other hardware for these doors to be under this cash allowance for supply only. All installation to be included in base bid tender price.
- 1.2.4 Supply and wiring of hardware items such as door monitoring contacts, card reader door access and combination magnetic fire door holder and closing units by Electrical Division. Installation of such hardware items by Section 06 41 00, Carpentry and Millwork under the supervision of Electrical Division.

1.3 REFERENCES

CAN/CGSB 69.25 M90	Cabinet Hardware
ANSI/BHMA 156.9-1982	
CAN/CGSB-69.34-93	Materials and Finishes
ULC	Underwriters Laboratories of Canada
WH	Warnock Hersey

1.4 SYSTEM DESCRIPTION

1.4.1 Keying System

- 1.4.1.1 Keying schedule to be provided by Police Service. Keying system shall include keying alike, keying differently, keying in groups, sub-master keying and grand-master keying locks as required.
- 1.4.1.2 Prepare and submit keying chart and related explanatory data to Consultant for approval. Do not commence lock work until written confirmation of keying arrangements is received from Consultant.

1.4.1.3 Supply following keys:

- 3 grand-master keys.
- 3 sub-master keys.
- 2 change keys for each lock.

1.4.1.4 Grand-master and sub-master keys shall not be delivered to Site, but shall be forwarded via registered mail with covering letter to Owner:

OR

1.4.1.5 Hand over keys to Owner.

1.5 **SUBMITTALS**

1.5.1 **Samples**

1.5.1.1 Submit samples of complete line of hardware and finishes to Consultant for approval, if and when requested, to accompany any proposal for substitution.

1.5.1.2 Hardware shall not be ordered from manufacturer until samples have been approved by Consultant and hardware and finishes supplied shall be identical with approved samples.

1.6 **DELIVERY, STORAGE AND HANDLING**

1.6.1 Pack hardware in suitable wrappings and containers to protect it from injury during shipping and storage. Accessories, fastening devices and other loose items shall be enclosed with each applicable item of hardware. Mark packages for easy identification as indicated on approved delivery schedule.

1.6.2 Deliver to building finish hardware for door listed in Door Schedule and hardware for cabinet work. Hand hardware over to trades which are designated to install it.

1.7 **WARRANTY**

1.7.1 Warrant work of this Section against defects and deficiencies for period of 5 years for door closers, and 2 years for other hardware, in accordance with General Conditions of the Contract. Promptly correct defects and deficiencies which become apparent within warranty period, to satisfaction to Consultant and at no expense to Owner.

2 Products

2.1 **MATERIALS**

2.1.1 **Hardware Schedule is based on following manufacturers':**

Hinges:	Hager Hinges Canada Ltd.
	Stanley Hardware
	Mont-Hard [Canada] Inc.

Locks/Stand-Alone Electronic Keypads: Best Universal Locks Ltd.
Sargent of Canada Ltd.
Schlage-Locks-Ingersoll-Rand
Door Hardware

Exit Devices: Von Duprin Exit Devices – Ingersoll-Rand Door Hardware
Magnokrom Inc.
American Device Mfg. Co.

Door Closers: LCN-Closers – Ingersoll-Rand Door Hardware
Sargent of Canada Ltd.
Dorma Door Controls Ltd.

Door Holders: Magnokrom Inc.
Glynn-Johnson Ingersoll-Rand Door Hardware
Canadian Builders Hardware Manufacture Inc.

Electric Strikes: Von Duprin
Folger Adam
ASSA Abloy
Hess (some models not acceptable on exterior applications)

Cylinders, Keyways: Abloy Keyway (No Substitutions)

Garage Door Opener: Commercial Grade – no remote access. Wall
mounted; no cables.

Digital Scramble Keypad: Hirsch Electronics or approved equal. High-
Intensity keypads are required on exterior locations
complete with MB5 mounting. Mounting height of
keypads to be 1478 mm (58") to centre above
ground.

2.2 **FABRICATION**

2.2.1 **Cabinet Abloy Locks and Padlock Hasp:**

2.2.1.1 Disc Tumbler Cam Lock: recessed fitting, left/right/vertical hand, nickel plated
steel finish, 7 disc size, cabinets and drawers where indicated) as manufactured
by Abloy. Type selected to approval of Tenant. All cabinet door and drawer
locks to be supplied by Hardware supplier and installed under Section 06 41 00
Finish Carpentry & Millwork.

2.2.1.2 Abloy Cam locks for **Millwork Lockers** to be supplied under this section and
installed under Section 06 41 00 Finish Carpentry & Millwork.

2.2.1.3 Padlock Hasp: PL204, non-handed locking plate with 12 mm shackle hole as
manufactured by Abloy.

2.2.1.4 Abloy locks for Constable lockers to be provided by Section 10 50 00 Lockers.

2.2.2 Strikes

2.2.2.1 Lock strikes shall be standard template box strikes, with extended lips to protect door frames and trim from marking with bolts, and shall be set flush in hollow metal door frames.

2.2.2.2 Blank standardized template strikes for hollow metal door frames shall be supplied as scheduled for such doors without locks.

2.2.3 Door Closers

2.2.3.1 Door closers shall be rack and pinion type with back checking feature and shall be of proper sizes to operate each respective door efficiently. Shaft packing shall be leak-proof.

2.2.4 Kick and Bumper Plates

2.2.4.1 Kick and bumper plates shall be as scheduled with edges cut square and smoothed off and shall have countersunk holes and oval head screws which shall be placed at each corner and symmetrically arranged at a maximum spacing of 200 mm (8") along edges.

2.2.4.2 Stainless steel kick plates shall be 1.27 mm (0.05") minimum thickness, satin finish, Type 304.

2.2.5 Thresholds

2.2.5.1 Supply thresholds complete with countersunk holes, and with screws and anchors as required for proper anchorage.

2.2.6 Fasteners

2.2.6.1 Supply hardware complete with screws, bolts, expansion shields and other fastening devices as required for satisfactory installation and operating of the hardware.

2.2.6.2 Supply fastening devices of same finish as hardware which is to be fastened.

2.2.6.3 Where pull is scheduled on one side of door, and push plate on other side, issue installation directions to trade responsible for fixing, so that the pull shall be secured through door from reverse side and push plate installed to cover screws. Flush pulls shall be supplied with machine screws for attaching as specified above.

2.2.7 Finishes

2.2.7.1 Type and finish of hardware shall be equal in all respects to samples of hardware and finishes approved by Consultant.

2.2.7.2 Metal finishes shall be free from defects, clean and unstained, and of uniform colour.

2.2.8 Finish hardware for fire rated doors shall meet requirements of ULC as part of fire rated door assembly and shall carry ULC or WH label.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Before furnishing any hardware, carefully check all architectural Drawings of work requiring hardware, verify door swings, door and frame material and operating conditions, and assure that hardware will fit work to which it is to be attached.

3.1.2 Check shop drawings and frame and door lists affecting hardware type and installation, and certify to correctness thereof, or advise Consultant in writing of required revisions.

3.1.3 **Templates:** Check Hardware Schedule, Drawings and Specifications, and furnish promptly to applicable trades any templates, template information and manufacturer's literature, required for proper preparation for and application of hardware, in ample time to facilitate progress of work.

3.1.4 **Co-ordinate delivery of Abloy Locks and Padlock hasps provided under this Section with Millwork Supplier for installation under Section 06 41 00 Finish Carpentry and Millwork.**

3.2 LOCATION OF HARDWARE

3.2.1 Hinge Locations

3.2.1.1 Doors 1981 mm to 2286 mm (6'-6" to 7'-6") in height and requiring 3 hinges.

- Top Hinge: 298 mm (11-3/4") maximum from centreline of hinge to frame head rabbet.
- Centre Hinge: equal distance from centre line of top and bottom hinge.
- Bottom Hinge: 330 mm (13") maximum from centreline of hinge to bottom of frame.

3.2.1.2 Doors 2311 mm (7'-7") and over in height and requiring 4 or more hinges.

- Top Hinge: 298 mm (11-3/4") maximum from centreline of hinge to frame head of rabbet.
- Centre Hinges: symmetrically spaced between top and bottom hinge.
- Bottom Hinge: 330 mm (13") maximum from centreline of hinge to bottom of frame.

3.2.2 **Lock Location:** 1024 mm (40-5/16") from centreline of lock to bottom of frame.

3.2.3 **Deadlock Strike Location:** 1200 mm (48") from centreline of strike to bottom of frame.

3.2.4 **Door Pulls**

3.2.4.1 1065 mm (42") from centreline of grip or push bar to bottom of frame.

3.2.5 **Push Plates:** 1143 mm (45") from centreline of plate to bottom of frame.

3.2.6 **Kick Plate:** Within 6 mm (1/4") of door bottom.

- Single Door Width: Push side; less 50 mm (2") of door width.
Pull side; less 25 mm (1") of door width.
- Double Door Width: Push side; less 25 mm (1") of door width.
Pull side; less 25 mm (1") of door width.

3.3 **SCHEDULES**

3.3.1 **Abbreviations:** Abbreviations used in Hardware Schedule are as follows:

3.3.1.1 Finishes: CGSB BHMA

Prime Coat	CP	600
Bright Brass (polished)	C3	605
Bright Nickel (polished)	C14	618
Dull Nickel	C15	619
Dull Nickel on Steel (hinges)	C15	646
Bright Chrome (polished)	C26	625
Dull Chrome	C26D	626
Satin Aluminum Anodized	C28	628
Bright Stainless Steel (polished)	C32	629
Dull Stainless Steel	C32D	630
Silver Aluminum Lacquer	SB/EN	628

3.3.1.2 Doors:

HMD	Hollow Metal Door
PL	Plastic Laminate
Kal	Kalamein
WD	Wood Door

3.3.1.3 Frames:

CIF	Channel Iron Frame
PSF	Pressed Steel Frame

3.3.1.4 Fastenings:

ATMS	Arm Template Machine Screws
ATB	Arm Through Bolts
BS	Backset
MS Machine Screws	
NRP	Non-Removable Pin
STS	Self Tapping Screws
STMS	Strike Template Machine Screws

TBGN	Through Bolts & Grommet Nuts
TMS	Template Machine Screws
WS	Wood Screws
WS/LS	Wood Screws/Lead Shields

3.3.1.5 Keying:

CMK	Construction Master Keyed
EK	Emergency Key
GMK	Grand Master Keyed
KA	Keyed Alike
KD	Keyed Different
MK	Master Keyed
SMK	Sub Master Key

End of Section.

August 06, 2026

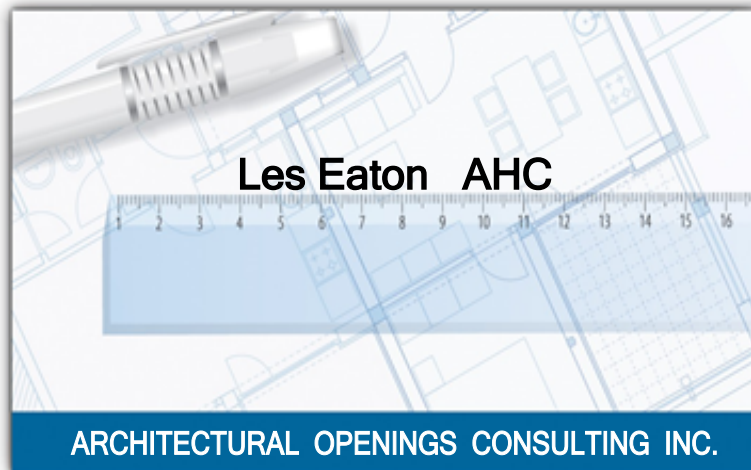
Revision: 5

Hardware List for:

Hanover Police Station

Architect:

+VG Architects



1 Pair of doors 101 Exterior

Aluminum frame

Aluminum door

2 x 965 x 2150 x 45

1	Continuous hinge	112XY x DH	628	Ives
1	Continuous hinge	112XY x EPT x DH	628	Ives
1	Power transfer	EPT 10	SP28	Von Duprin
1	Exit device	QEL-35A-NL-OP x 388 x DW	626	Von Duprin
1	Exit device	CD-35A-EO x DW	626	Von Duprin
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
2	Door pull	8190HD-0	630	Ives
1	Removable Mullion	5654	US28	Von Duprin
1	Automatic surface door operator	9542 Push side mounting)	689	LCN
1	Actuators	8310-852-876	630	LCN
1	Actuators	8310-852	630	LCN
1	Surface door closer	4040XP x 4040XP-18TJ	689	LCN
1	Overhead concealed door stop	GJ100S x ADJ x DW	630	Glynn Johnson
1	Overhead concealed door stop	GJ100S x DW	630	Glynn Johnson
1	Threshold	624A x DW	628	Zero International
2	Door sweep	8192AA x DW	Alum	Zero International
1	Power supply	PS902 x 2RS		Von Duprin
1	Keypad	By Security		
1	Card reader & door contacts	By Security		

Balance of weatherseal complete by the aluminum door and frame supplier

1 Pair of doors 102A Vestibule

Aluminum frame

Aluminum door

2 x 965 x 2150 x 45

1	Continuous hinge	112XY x DH	628	Ives
1	Continuous hinge	112XY x EPT x DH	628	Ives
1	Power transfer	EPT 10	SP28	Von Duprin
1	Exit device	QEL-35A-NL-OP x 388 x DW	626	Von Duprin
1	Exit device	CD-35A-EO x DW	626	Von Duprin
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
2	Door pull	8190HD-0	630	Ives
1	Removable Mullion	5654	US28	Von Duprin
1	Automatic surface door operator	9542 Push side mounting)	689	LCN
1	Actuators	8310-852-876	630	LCN
1	Actuators	8310-852	630	LCN
1	Surface door closer	4040XP x 4040XP-18TJ	689	LCN
1	Overhead concealed door stop	GJ100S x ADJ x DW	630	Glynn Johnson
1	Overhead concealed door stop	GJ100S x DW	630	Glynn Johnson
1	Power supply	PS902 x 2RS		Von Duprin
1	Keypad	By Security		
1	Card reader & door contacts	By Security		

1 Single door 102B Circulation/Public Lobby

Pressed steel frame

Wood door

950 x 2150 x 45

STC50

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Keypad	By Security		
1	Card reader & door contacts	By Security		

Sound seal by door/frame supplier

1 Single door 103 Universal Washroom 103

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives

1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Automatic surface door operator	9131 (pull side mtg)	689	LCN
1	Washroom package	CX-WC13AXFM-PS		Camden
	<i>Complete with electric strike for a mortise lockset</i>			
1	Audible alarm/ light Package	CX-WEC10K2		Camden
1	Kick plate	8400 400mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Single door 104 Prob Room

Pressed steel frame

PL wood door

950 x 2150 x 45

STC46

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Passage set	L9010 x 06B	626	Schlage
1	Floor stop	FS439	626	Ives
	<i>Sound seal by door/frame supplier</i>			

1 Single door 106A Interview

Pressed steel frame

Wood door

950 x 2150 x 45

STC50

4	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Card reader & door contacts	By Security		
	<i>Sound seal by door/frame supplier</i>			

1 Single door 106B Interview

Pressed steel frame

Wood door

950 x 2150 x 45

STC50

4	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Keypad	By Security		
1	Card reader & door contacts	By Security		
Sound seal by door/frame supplier				

1 Single door 107A Front Desk

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

4	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Keypad	By Security		
1	Card reader & door contacts	By Security		
Sound seal by door/frame supplier				

1 Single door 107B Front Desk

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

4	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage

1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Keypad	By Security		
1	Card reader & door contacts	By Security		
	Sound seal by door/frame supplier			

1 Single door 109 Multi-Purpose

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives

1 Single door 108 Administration

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Office function lockset	L9050L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives

Sound seal by door/frame supplier

1 Single door 112 Sgt Office

Pressed steel frame

Wood door

950 x 2150 x 45

STC50

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Office function lockset	L9050L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives
Sound seal by door/frame supplier				

1 Single door 114 Evidence

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Keypad	By Security		
1	Card reader & door contacts	By Security		

1 Single door 115 Use of Force

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives

1 Single door 117 Monitor

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives

1 Single door 116 Janitor

Pressed steel frame 0 Hour

Hollow metal door 0 Hour

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Single door 118 Universal Washroom 118

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Automatic surface door operator	9131 (pull side mtg)	689	LCN
1	Washroom package	CX-WC13AXFM-PS <i>Complete with electric strike for a mortise lockset</i>		Camden
1	Audible alarm/ light Package	CX-WEC10K2		Camden
1	Kick plate	8400 400mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Single door 119A Police Garage (Exterior)

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Floor stop	FS439	626	Ives
1	Weatherseal/soundseal	188S x 2 x DH x 2 x DW	Install on a clean dry surface	Zero International
1	Threshold	624A x DW	628	Zero International
1	Door sweep	CT-730 x DW	628	KN Crowder
1	Release Button	By Security		

1 Single door 113 SOCO

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives

1 Single door 119C Police Garage

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Keypad	By Security		
1	Card reader & door contacts	By Security		

1 Single door 120 Boiler

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives

1 Single door 122 Electrical

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Floor stop	FS439	626	Ives
1	Weatherseal/soundseal	188S x 2 x DH x 2 x DW	Install on a clean dry surface	Zero International
1	Threshold	624A x DW	628	Zero International
1	Door sweep	CT-730 x DW	628	KN Crowder

1 Single door 123 Booking Area

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

4	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin

1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Card reader & door contacts	By Security		
1	Keypad	By Security		
Sound seal by door/frame supplier				

1 Single door 124 Interview

Pressed steel frame

Hollow metal door

950 x 2150 x 45

STC50

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Office function lockset	L9050L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Overhead surface door stay	GJ90S x DW	630	Glynn Johnson
Sound seal by door/frame supplier				

1 Single door 125 Interview/Breath

Pressed steel frame

Hollow metal door

950 x 2150 x 45

STC50

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Office function lockset	L9050L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives
Sound seal by door/frame supplier				

1 Single door 126 Storage

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Passage set	L9010 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage

1	Floor stop	FS439	626	Ives
<i>Sound seal by door/frame supplier</i>				

1 Single door 127 Phone Booth

Pressed steel frame

Hollow metal door

950 x 2150 x 45

STC50

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Office function lockset	L9050L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives
<i>Sound seal by door/frame supplier</i>				

1 Single door 128A Cell #4

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200 mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Single door 128B Chase 3

Pressed steel frame 0 Hour

Hollow metal door 0 Hour

710 x 1934 x 45

3	Hinges	3CB1 114 x 102 NRP	652	Ives
1	Storeroom function lockset	L9080L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	1461 Cush	689	LCN

1 Single door 129B Chase 2

Pressed steel frame 0 Hour

Hollow metal door 0 Hour

860 x1934 x 45

3	Hinges	3CB1 114 x 102 NRP	652	Ives
1	Storeroom function lockset	L9080L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	1461 Cush	689	LCN

1 Single door 131B Chase 1

Pressed steel frame 0 Hour

Hollow metal door 0 Hour

710 x1934 x 45

3	Hinges	3CB1 114 x 102 NRP	652	Ives
1	Storeroom function lockset	L9080L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	1461 Cush	689	LCN

1 Single door 132A Sallyport

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652		Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626		Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626		Schlage
1	Electric strike	6211-FSE-DS-24-S024	630		Von Duprin
1	Surface door closer	4040XP Rw/PA	689		LCN
1	Kick plate	8400 200mm x DW x B-NHA	630		Ives
1	Floor stop	FS439	626		Ives
1	Weatherseal/soundseal	188S x 2 x DH x 2 x DW	Install on a clean dry surface	blk	Zero International
1	Threshold	624A x DW	628		Zero International
1	Door sweep	8192AA x DW	Alum		Zero International
2	Keypad	By Security			
1	Card reader & door contacts	By Security			

1 Single door 132C Cell Vestibule

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652		Ives
1	Classroom function lockset	L9070L x 06B	626		Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626		Schlage
1	Surface door closer	4040XP Rw/PA	689		LCN
1	Kick plate	8400 200 mm x DW x B-NHA	630		Ives
1	Floor stop	FS439	626		Ives

1 Single door 133 Public Washroom

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1HW 127 x 114 NRP	630		Ives
1	Privacy set	L9456L 06B L583-363 L283-722	626		Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626		Schlage
1	Surface door closer	4040XP Rw/PA	689		LCN

1	Floor stop	FS439	626	Ives
1	Weatherseal/soundseal	188S x 2 x DH x 2 x DW	Install on a clean dry surface blk	Zero International
1	Threshold	624A x DW	628	Zero International
1	Door sweep	CT-730 x DW	628	KN Crowder

1 Single door 134A Vestibule

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Exit device	98L-06 x DW	626	Von Duprin
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Floor stop	FS439	626	Ives
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives

1 Single door 134B Vestibule

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	630	Ives
1	Exit device	98L-06 x DW	626	Von Duprin
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP SCUSH	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Threshold	624A x DW	628	Zero International
1	Weatherseal/soundseal	429A x 1 x DW x 2 x DH	628	Zero International
1	Door sweep	8192AA x DW	628	Zero International

1 Single door 134C Vestibule

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Exit device	98L-06 x DW Less dogging	626	Von Duprin
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6300-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
2	Keypad	By Security		
1	Card reader & door contacts	By Security		

1 Single door 139 Vestibule

Aluminum frame

Aluminum door

965 x 2150 x 45

1	Continuous hinge	112XY x EPT x DH	628	Ives
1	Power transfer	EPT 10 SP28		Von Duprin
1	Exit device	QEL-35A-NL-OP x 388 x DW	626	Von Duprin
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Door pull	8190HD-0	630	Ives
1	Automatic surface door operator	9542 Push side mounting)	689	LCN
1	Actuators	8310-852-876	630	LCN
1	Actuators	8310-852	630	LCN
1	Overhead concealed door stop	GJ100S x ADJ x DW	630	Glynn Johnson
1	Threshold	624A x DW	628	Zero International
1	Door sweep	8192AA x DW Alum		Zero International
1	Power supply	PS902 x 2RS		Von Duprin
1	Keypad	By Security		
1	Card reader & door contacts	By Security		

Balance of weatherseal complete by the aluminum door and frame supplier

1 Single door 140A Vestibule

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	630	Ives
1	Exit device	98L-06 x DW	626	Von Duprin
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP SCUSH	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Threshold	624A x DW	628	Zero International
1	Weatherseal/soundseal	429A x 1 x DW x 2 x DH	628	Zero International
1	Door sweep	8192AA x DW	628	Zero International

1 Single door 140B Vestibule

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Push bar	350 x DW	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Single door 141A Cell Vestibule

Pressed steel frame

Hollow metal door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200 mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Single door S11A Stair 1

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	630	Ives
1	Exit device	98L-06 x DW	626	Von Duprin
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP SCUSH	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Threshold	624A x DW	628	Zero International
1	Weatherseal/soundseal	429A x 1 x DW x 2 x DH	628	Zero International
1	Door sweep	8192AA x DW	628	Zero International

1 Single door S11B Stair 1

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Exit device	98L-06 x DW	626	Von Duprin
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Floor stop	FS439	626	Ives
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives

1 Single door S21 Stair 2

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Passage set	L9010 x 06B	626	Schlage
1	Floor stop	FS439	626	Ives

1 Single door 201A Traing/Briefing

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Overhead concealed door stop	GJ100H x DW	630	Glynn Johnson

1 Single door 201B Training/Briefing

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Keypad	By Security		
1	Card reader & door contacts	By Security		

1 Pair of doors 202A Storage

Pressed steel frame

Wood door

2-650 x 2150 x 45

6	Hinges	3CB1 114 x 102 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Set of flushbolts	457 x DP2	626	Ives
2	Overhead concealed door stop	GJ100H x DW	630	Glynn Johnson

1 Pair of doors 202B Storage

Pressed steel frame

Wood door

2-650 x 2150 x 45

6	Hinges	3CB1 114 x 102 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Set of flushbolts	457 x DP2	626	Ives
2	Overhead concealed door stop	GJ100H x DW	630	Glynn Johnson

1 Single door 203 Waiting Area

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Exit device	98L-06 x DW Less dogging	626	Von Duprin
1	Rim Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6300-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Keypad	By Security		
1	Card reader & door contacts	By Security		

1 Single door 204 Administration

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Card reader & door contacts	By Security		
1	Keypad	By Security		

1 Single door 205 Project Room

Pressed steel frame

Wood door

950 x 2150 x 45

STC 46

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives
Sound seal by door/frame supplier				

1 Single door 206 Chiefs Office

Pressed steel frame

Wood door

950 x 2150 x 45

STC 50

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Card reader & door contacts	By Security		
1	Keypad	By Security		
<i>Sound seal by door/frame supplier</i>				

1 Single door 207 Deputy Chief

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Office function lockset	L9050L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives
<i>Sound seal by door/frame supplier</i>				

1 Single door 209 IT Room

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652		Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626		Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626		Schlage
1	Electric strike	6211-FSE-DS-24-S024	630		Von Duprin
1	Surface door closer	4040XP Rw/PA	689		LCN
1	Kick plate	8400 200mm x DW x B-NHA	630		Ives
1	Floor stop	FS439	626		Ives
1	Card reader & door contacts	By Security			
1	Keypad	By Security			

1 Single door 210 QM Storage

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652		Ives
1	Classroom function lockset	L9070L x 06B	626		Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626		Schlage
1	Floor stop	FS439	626		Ives

1 Single door 211 Records

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652		Ives
1	Classroom function lockset	L9070L x 06B	626		Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626		Schlage
1	Floor stop	FS439	626		Ives

1 Single door 212 Soft Interview

Pressed steel frame

Wood door

950 x 2150 x 45

STC50

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Office function lockset	L9050L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives
Sound seal by door/frame supplier				

1 Single door 213 MHRT

Pressed steel frame

Wood door

950 x 2150 x 45

STC46

4	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Office function lockset	L9050L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives
Sound seal by door/frame supplier				

1 Single door 214 Universal Washroom

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Automatic surface door operator	9131 (pull side mtg)	689	LCN
1	Washroom package	CX-WC13AXFM-PS		Camden
	<i>Complete with electric strike for a mortise lockset</i>			
1	Audible alarm/ light Package	CX-WEC10K2		Camden
1	Kick plate	8400 400mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Single door 215 Closet

Pressed steel frame

Wood door

750 x 2150 x 45

3	Hinges	3CB1 114 x 102 NRP	652	Ives
1	Passage set	L9010 x 06B	626	Schlage

1 Overhead concealed door stop GJ100S x DW 630

Glynn Johnson

1 Single door 216A Lunch Room

Pressed steel frame

LOCK

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Floor stop	FS439	626	Ives

1 Single door 216B Lunch Room

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1HW 127 x 114 NRP	630	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP S Cush	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Threshold	624A x DW	628	Zero International
1	Weatherseal/soundseal	429A x 1 x DW x 2 x DH	628	Zero International
1	Door sweep	8192AA x DW	628	Zero International
1	Card reader & door contacts	By Security		
1	Keypad	By Security		

1 Single door 217 Womens Washroom

Pressed steel frame

LOCK

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Push plate	8200 100 mm x 400 mm x BHMA	Install over the top of the door pull through bolts 630	Ives
1	Door pull	8103EZHD-10"	630	Ives
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Pair of doors 218A Storage

Pressed steel frame

Wood door

2-650 x 2150 x 45

6	Hinges	3CB1 114 x 102 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Set of flushbolts	457 x DP2	626	Ives
2	Overhead concealed door stop	GJ100H x DW	630	Glynn Johnson

1 Pair of doors 218B Storage

Pressed steel frame

Wood door

2-650 x 2150 x 45

6	Hinges	3CB1 114 x 102 NRP	652	Ives
1	Classroom function lockset	L9070L x 06B	626	Schlage
1	Set of flushbolts	457 x DP2	626	Ives
2	Overhead concealed door stop	GJ100H x DW	630	Glynn Johnson

1 Single door 219 Mens Washroom

Pressed steel frame

LOCK

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Push plate	8200 100 mm x 400 mm x BHMA	Install over the top of the door pull through bolts 630	Ives
1	Door pull	8103EZHD-10"	630	Ives
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives

1	Floor stop	FS439	626	Ives

1 Single door 220A Fitness Room

Pressed steel frame

LOCK

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Push plate	8200 100 mm x 400 mm x BHMA	Install over the top of the door pull through bolts	Ives
1	Door pull	8103EZHD-10"	630	Ives
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives

1 Single door 222 Corridor

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Storeroom function lockset	L9080L x XL11-422 x 06B	626	Schlage
1	Mortise Cylinder	High Security, RC, CC, with permanent Classic Primus XP	626	Schlage
1	Electric strike	6211-FSE-DS-24-S024	630	Von Duprin
1	Surface door closer	4040XP Rw/PA	689	LCN
1	Kick plate	8400 200mm x DW x B-NHA	630	Ives
1	Floor stop	FS439	626	Ives
1	Card reader & door contacts	By Security		
1	Keypad	By Security		

1 Single door S22 Stair 2

Pressed steel frame

Wood door

950 x 2150 x 45

3	Hinges	3CB1 127 x 114 NRP	652	Ives
1	Passage set	L9010 x 06B	626	Schlage
1	Surface door closer	4040XP Rw/PA	689	LCN

1	Kick plate	8400 200mm x DW	x B-NHA	630	Ives
1	Floor stop	FS439	626		Ives

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.1.1 The work of this Section is to form part of the base bid tender price is **NOT** part of the cash allowance. Work includes supply and installation of all components required to provide a complete power door operator at each location required including actuators.

1.1.2 Coordinate with Electrical for power and rough-in requirements.

1.2 RELATED SECTIONS

1.2.1 Supply of hinges and manual door closer: Section 08710 - Finish Hardware; installation by this Section.

1.2.2 Electrical wiring to manufacturer's equipment: Division 16 – Electrical.

1.3 REFERENCES

ANSI/BHMA A156.19-90	Power Assist and Low-Energy Power-Operated Doors

1.4 SYSTEM DESCRIPTION

1.4.1 Barrier free door operation system comprising of low energy power operator with optional push and go door system as defined in ANSI/BHMA A156.19.

1.5 SUBMITTALS

1.5.1 Submit shop drawings in accordance with Section 01330 Administrative Requirements.

1.5.2 Clearly indicate materials being supplied and shall have all connections, attachments, reinforcing, anchorage and location of exposed fastenings.

1.6 WARRANTY

1.6.1 Warrant work of this Section against defects and deficiencies in accordance with General Conditions of the Contract. Promptly make good defects and deficiencies which become apparent within warranty period, to satisfaction of Architect and at no extra cost to the Owner.

2 PRODUCTS

2.1 FABRICATION AND MANUFACTURER OF EQUIPMENT

2.1.1 Manufacturer

2.1.1.1 Interior Heavy Duty Door Operator: Design is based on low energy power operated door operating equipment, surface applied #5663 by Dor-O-Matic of Canada Inc. Following products are also acceptable provided they meet

requirements of those specified.

Besum of Canada surface mounted: 450 series

Stanley Magic Door Division
of Stanley Canada Inc. surface mounted: magic swing surface

Horton Automatics surface mounted: 4,000 series surface

Gyro, Tech. Inc. surface mounted: GT500 surface

2.1.1.2 Door operating equipment shall be complete with electro mechanical motor gear box. Provide 3 position (off-on) switch. System shall operate between -34 deg C and 71 deg C (-29 deg F and 160 deg F).

2.1.1.3 Provide housing of the same dimension and finish as the door operator housing and install to full width of the screen or frame in which the door operator is being installed. Install in-line at the same elevation as the door operator to create the appearance that the door operator housing extends the full width of the screen or frame in which it is installed.

2.1.2 Functional Requirements

2.1.2.1 Equipment shall be designed to operate swing doors up to weight of 102 kg (225 lbs).

2.1.2.2 Opening Speed:

- Door shall be field adjusted to back check as required in Table 1 of ANSI/BHMA A156.19.
- Opening speed to fully open shall be 4 seconds or longer.

2.1.3 Hold Open: Door shall be field adjusted to remain fully open for not less than 5 seconds or more than 30 seconds.

2.1.4 Closing Speed

- Doors shall be field adjusted to close 90° to 10° in 3 seconds or longer as required in Table 1 of ANSI/BHMA A156.19.
- Doors shall close from 10° to fully closed in not less than 1.5 seconds.
- Force required to prevent door from opening or closing shall not exceed 7 kg applied 25 mm (1") from latch edge of door at any point in opening or closing cycle.
- During power failure, doors shall open with manual pressure not exceeding 11.3 kg at point 25 mm (1") from latch edge of door.
- Doors shall be equipped with signs visible from either side, instructing user as to operation and function of door.

2.1.5 System Operation: Where 1 of push buttons on either side of door is actuated door shall open slowly to back check (80°) in 3 to 6 seconds and to full open position in 4 to 7 seconds. Door shall remain open for period set to suit requirements (period of 5 to 30 seconds). After time delay door shall close by spring in door operator from 90° to 10° in 3 to 6 seconds from 10° to fully closed in 1-1/2 to 2 seconds.

2.1.6 Requirements

2.1.6.1 Provide header complete with full housing, finish shall match door frame finish.

2.1.6.2 Operator shall be activated by push button switches on either sides as indicated. Switches shall be located no more than 1200 mm (48") from floor. Switches shall bear universal handicap logo visible to all types of traffic.

3 EXECUTION

3.1 INSTALLATION AND OPERATION

3.1.1 Provide automatic door operators, controls and accessories for doors indicated.

3.1.2 Doors shall operate manually as though equipped with manual door closers, without damage to automatic door components, in event of power failure or in event of power termination.

3.1.3 Door operators and accessories shall be installed in strict accordance with manufacturer's recommendations.

3.1.4 Power supply to each door operator and wiring shall be provided by Division 16 - Electrical. Make connections at operators and at control panel and supply and install each electrical work between operators and activating controls. Comply with requirements of Division 16 - Electrical. All wiring shall be concealed and where exposed shall be run in conduit. Location of exposed wiring shall be subject to Architect's approval.

3.2 ADJUST AND CLEAN

3.2.1 Test and adjust operators and controls smooth and proper operation.

3.2.2 Upon completion of Work of this Section, remove from Site all debris, equipment and excess material resulting from Work of this Section.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

1.2.1 Installation of security finish hardware: Section 08 34 20 - Security Door and Frames & Section 11 19 10 Sliding Cell Doors, Screens and Equipment

1.2.2 Installation of conventional finish hardware: Section 06 41 00 - Finish Carpentry and Millwork, Section 08 11 00 - Steel Doors and Frames.

1.3 SYSTEM DESCRIPTION

1.3.1 Key out keying system for building in consultation with Tenant, which keying system includes keying alike, keying differently, and keying in groups. No master keys or construction keys of any kind are permitted.

1.3.2 Prepare and submit a keying chart and related explanatory data to Consultant for his approval. Do not commence lock work until written confirmation of keying arrangements is received from Consultant in consultation with Tenant.

1.3.3 **All detention doors (sliding cell doors, swinging cell doors and plumbing chase doors) to have detention locks to be keyed alike to a new key code and three (6) keys issued to West Grey Police Service.**

1.3.4 Do not delivery keys to Site. Send keys via courier or registered mail with covering letter to Police Service direct. Failure to follow this procedure will result in re-keying of all locks and provision of new keys at no cost to the Contract.

1.4 SUBMITTALS

1.4.1 **Shop Drawings:** Submit shop drawings in accordance with Section 01 33 00 Administrative Requirements for locking and operating devices.

1.4.2 Operation and Maintenance Data

1.4.2.1 Submit 6 copies of maintenance, operating and repair parts manuals relative to each type of lock and locking device. Ensure manuals contain parts information in a form acceptable to Consultant.

1.4.2.2 Submit installation instructions for hardware installation purposes.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Pack hardware in suitable wrappings and containers to protect it from injury during shipping and storage. Enclose accessories, fastening devices and other loose items with each applicable item of hardware. Mark packages for each identification as indicated on approved delivery schedule.

- 1.5.2 Deliver to building finish hardware for doors listed in Door Schedule and specified herein. Hand hardware over to trades which are designated to install it.

1.6 **WARRANTY**

- 1.6.1 Warrant work of this Section against defects and deficiencies for period of 5 years for door closers and for period of 2 years for other hardware in accordance with General Conditions of the Contract. Promptly correct defects and deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no cost to Owner.

2 **PRODUCTS**

2.1 **MANUFACTURERS**

- 2.1.1 Before installing any security finish hardware obtain manufacturer's advice on installation procedures applicable to each case.
- 2.1.2 Arrange for a competent representative of manufacturer to visit Site during installation period to ensure security finish hardware is being properly installed.

2.2 **MATERIALS**

2.2.1 **Acceptable Hardware Manufacturers: Folger Adams, Southern Steel, RR Brink.**

- 2.2.1.1 Refer to drawings for security/detention hardware.
- 2.2.1.2 For conventional hardware, refer to Hardware Schedule.

2.3 **FABRICATION**

- 2.3.1 **Strikes:** Use standard template box strikes for lock strikes, with extended lips to protect door frames and trim from marking with bolts, and set flush in hollow metal door frames.
- 2.3.2 **Door Closers:** Use rack and pinion type with back checking feature and of proper sizes to operate each respective door efficiently. Ensure shaft packing is leakproof.
- 2.3.3 **Kick and Bumper Plates**
- 2.3.3.1 Supply with edges cut square and smoothed off, countersunk holes and oval or flat head security torx screws of same material placed at each corner and symmetrically arranged at a maximum spacing of 200 mm (8") along edges.
- 2.3.3.2 Supply stainless steel kick plates 1.27 mm (No.0.05") minimum thickness, satin finish.
- 2.3.4 **Thresholds:** Supply thresholds complete with countersunk holes, screws and anchors as required for proper anchorage.

2.3.5 Finish Hardware for Fire Rated Doors: Ensure finish hardware for fire rated door meets requirements of ULC as part of fire rated door assembly and carries ULC component label on each lock together with Model No. and electrical rating on electro-mechanical lock.

2.3.6 Cylinders

2.3.6.1 Provide cylinders for security locks of 1 manufacturer unless otherwise specified herein.

2.3.6.2 For conventional locksets, supplied by manufacturers listed herein.

2.3.6.3 Mogul Cylinders: Provide "mogul" type key cylinders with 50 mm (2") barrel diameter, containing 5 stainless steel tumblers with stainless steel balls engaging tumblers and key.

2.3.7 Keys

2.3.7.1 Ensure keys or security locks with mogul cylinders are not less than 73 mm (2-7/8") in length, blade 14 mm (9/16") wide x 3 mm (1/8") thick). Provide 25 mm (1") diameter handles.

2.3.7.2 Ensure keys for lever tumbled prison locks are not less than 114 mm (4-1/2") in length with a blade 4 mm (5/32") thick. Ensure keys have overlapping paracentric grooves matching similar grooves in lock cylinder. Provide oval shaped handle to fit hand. Fabricate key from polished alloy bronze having a tensile strength of not less than 620 MPa (90,000) and a hardness on the Brinell scale of at least 150.

2.3.7.3 Supply keys for conventional locks from 1 manufacturer unless specified otherwise herein and approved by Consultant. Ensure duplicates are not available at local key shops. Ensure they are available only from controlled Canadian sources explicitly authorized to produce same by cylinder manufacturer. Restrict key section to exclusive use of West Grey Police Service. Stamp each key of whatever type with number or letter as directed.

2.3.8 Fasteners for Security Hardware

2.3.8.1 Provide security type exposed screws, bolts and nuts. Those in areas not required to be removed and those on prisoner side of any construction, shall be either flat head or round head, having an extra head which will twist off or chip off when fully secured, leaving main head flush or projected without slots.

2.3.8.2 In other areas, where it is necessary to remove items screws shall have slots or holes that require a special spanner tool for their removal and shall be such that standard tools will not fit.

2.3.8.3 Ensure fastening devices are same finish as hardware which is to be fastened.

2.3.8.4 Ensure expansion shields for setting in concrete or concrete block are manufactured by a recognized manufacturer. Clearly shown each type of fastener on shop drawings.

2.3.9 Fasteners for Conventional Hardware

- 2.3.9.1 Supply conventional hardware complete with security screws, bolts, expansion shields and other fastening devices as required for satisfactory installation and operating of hardware.
- 2.3.9.2 Ensure fastening devices are of same finish as hardware to be fastened.
- 2.3.9.3 Where a pull is scheduled on 1 side of door and a push plate on other side, issue installation directions to trade responsible for fixing, so pull is secured through door from reverse side and push plate installed to cover screws. Supply flush pulls with machine screws for attaching as specified above.

2.3.10 Finishes

- 2.3.10.1 Type and finish of all hardware supplied under this Section shall be equal in all respects to samples of hardware and finishes approved by Consultant.
- 2.3.10.2 Those items of hardware which will have CP finish shall have 1 shop coat of compatible primer and be ready to receive finish paint specified by Section 09 91 00, Painting and Finishing after installation.
- 2.3.10.3 Ensure paint finishes are free from defects, clean and unstained, and of a uniform colour.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Before supplying any hardware, carefully check Architectural Drawings of the work requiring hardware. Verify door swings, door and frame material and operating conditions, and assure hardware will fit Work to which it is attached.
- 3.1.2 Check shop drawings and frames and door lists affecting hardware type and installation, and certify correctness thereof, or advise Consultant in writing of required revisions.
- 3.1.3 Check hardware schedule, Drawings and Specifications, and supply promptly to applicable trades any patterns, templates, template information and manufacturer's literature, required for proper preparation for and application of hardware, in ample time to facilitate progress of Work.

3.2 INSTALLATION

- 3.2.1 Assist and supervise hardware installation supplied by this Section.

3.3 SCHEDULES

3.3.1 Abbreviations used in hardware schedule are as follows:

3.3.1.1 Canadian Standard Finishes:

CP	Prime Coat
CIB	Bright Japanned
C2C	Cadmium Plated
C2G	Bright Zinc
C3	Bright Brass (polished)
C4	Dull Brass
C9	Bright Bronze (polished)
C10	Dull Bronze
C14	Bright Nickel (polished)
C15	Dull Nickel
C19	Satin Black Lacquer
C20D	Dark Anodized, Statuary Bronze
C26	Bright Chrome (polished)
C26D	Dull Chrome
C27	Satin Aluminum Lacquered
C28	Satin Aluminum Anodized
C32	Bright Stainless Steel (polished)
C32D	Dull Stainless Steel
SB	Silver Aluminum Lacquer

3.3.1.2 Symbols:

AL	Aluminum
ASA	Standard Strike for Metal Frames
ATMS	Arm Template Machine Screws
ATB	Arm Through Bolts
BS	Backset
B4E	Bevelled 4 Edges
BL	Bolt Locked Limit Switch in Device
CC	Centre to Centre
Cy	Cylinder
CIF	Channel Iron Frame
CMK	Construction Master Keyed
DS	Dead Stop
Dr	Door
DA	Double Acting
EK	Emergency Key
FC	Flexible Connector
FMS	Full Machine Screw
GALV	Galvanized
GMK	Grand Master Keyed
HM	Hollow Metal
HO	Hold Open
KA	Keyed Alike
KD	Keyed Different
Kal	Kalamein

K1S Keyed One Side
K2S Keyed Two Sides
KLE Knob Lock (Electric) One Side only
KLE2(Knob Lock (Electric) Two Sides
LS Lead Shields
MK Master Keyed MS Machine
Screws NK No Knob
NRP Non-Removable Pin
PA Parallel Arm
PHS Phillips Head Screws
PSF Pressed Steel Frame
PL Plastic Laminate
RBL Reverse Operation and incl. Bolt Locked Limit Switch in Device
SCS Security Screws (with Twist-off Head)
SK Security Knob (One Side only)
SMK Sub Master Key
SMS Sheet Metal Screws
SPS Spanner Screws
SW One Limit Switch included Inside Lock Case.
2SW Two Limit Switches included Inside Lock Case.
STMS Strike Template Machine Screws.
STS Self Tapping Screws
TB Through Bolts
TBGN Through Bolts and Grommet Nuts
TMS Template Machine Screws
TT Thumb Turn
WBX Wrought Box

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

1.2.1 Millwork: Section 06 41 00

1.2.2 Supply of steel doors, screens and wood doors: Section (08 11 00, Steel Doors and Frames and Screens and Section 08 14 00, Wood Doors.

1.2.3 Glass and glazing for aluminum framing at Millwork and aluminum entrance and screen: Section 08 41 00, Aluminum Framing & 08 41 10 Aluminum Entrance and Screen.

1.2.4 Glass for Curtain Wall and Windows: Section 08 44 13 Curtain Wall

1.2.5 Unit mirrors: Section 10 80 00, Washroom Accessories.

1.2.6 Security and Privacy Film: Section 12 49 70 Window Film

1.3 REFERENCES

ASTM C509-00	Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C542-94(1999)	Specification for Lock-Strip Gaskets
ASTM D790-02	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
ASTM D1003-00	Test Method for Haze and Luminous Transmittance of Plastics.
ASTM D1044-99	Test Method for Resistance of Transparent Plastics to Surface Abrasion
ASTM D1929-96(R2001)e1	Test Method for Ignition Properties of Plastics.
ASTM D2240-02b	Test Method for Rubber Property - Durometer Hardness.
ASTM E84-01	Test Method for Surface Burning Characteristics of Building Materials.
ASTM E90-02	Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM F1233-98	Test Method for Security Glazing Materials and Systems.
CAN/CGSB-12.1-M90	Tempered or Laminated Safety Glass
CAN/CGSB-12.3-M91	Flat, Clear Float Glass
CAN/CGSB-12.4-M91	Heat Absorbing Glass
CAN/CGSB-12.5-M86	Mirrors, Silvered
CAN/CGSB-12.11-M90	Wired Safety Glass
CAN/CGSB-12.12-M90	Plastic Safety Glazing
CAN/CGSB-12.13-M91	Patterned Glass
CAN/CGSB-12.20-M89	Structural Design of Glass Buildings

CAN/CGSB-19.13-M87	Sealing Compound, One-Component, Elastomeric, Chemical Curing
CAN/CGSB-19.18-M87	Sealing Compound, One-Component, Silicone Base, Solvent Curing (WITHDRAWN)
CAN/CGSB-19.24-M90	Multi-component, Chemical-Curing Sealing Compound
Glazing Manual IGMAC	Glass Association of North America (GANA) Insulating Glass Manufacturer=s Association of Canada.
LSGASM	Laminators Safety Glass Association Standards Manual.

1.4 **QUALITY ASSURANCE**

- 1.4.1 Conform to OBC design requirements and design glass and glazing to CAN/CGSB-12.20-M89. In case of discrepancies most stringent requirements shall govern.
- 1.4.2 Perform work in accordance with Glass Association of North America (GANA) Glazing Manual, Insulating Glass Manufacturers Association of Canada, (IGMAC), and Laminators Safety Glass Association (LSGASM) - Standards Manual for glazing installation methods. Insulating glass units shall be fabricated by manufacturer who has certified these units in accordance with IGMAC Certification Programme. Insulation glass unit shall bear a valid number on latest IGMAC Certification Programme.
- 1.4.3 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.

1.5 **SUBMITTALS**

- 1.5.1 **Maintenance Data** : Provide maintenance data indicating cleaning instructions for inclusion into Maintenance Manual

1.6 **WARRANTY**

- 1.6.1 Warrant mirror's silvering from deteriorating for period of 10 years in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period to satisfaction of Owner and at no expense to Owner.

2 **PRODUCTS**

2.1 **MATERIALS**

- 2.1.1 **Insulating glass units for exterior units, Curtain Wall and Windows:** To CAN/CGSB-12.8, double glazed, hermetically sealed, argon filled insulating glass units with low conductance black stainless steel warm edge spacer.
 - .1 Outer lite: 6 mm (0.25 inches) clear float glass with high performance low-E coating on surface two AG 43 by Guardian Glass or equal
 - .2 Inner lite: 6 mm (0.25 inches) clear float glass.
- 2.1.2 **Insulating glass units for Exterior HM Doors:** To CAN/CGSB-12.8, double glazed, hermetically sealed, argon filled insulating glass units with low conductance black stainless steel warm edge spacer.

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- .1 Outer lite: 6 mm (0.25 inches) clear tempered glass with low-E by Guardian Glass or equal
 - .2 Inner lite: 6 mm (0.25 inches) clear tempered glass.
- 2.1.3 **Float Glass:** CAN/CGSB-12.3-M, glazing quality, thicknesses shall be as indicated on Drawings.
- 2.1.4 **Wired Glass:** CAN/CGSB-12.11-M, 6 mm (1/4") thick, clear Georgian wired glass, Type 1, polished both sides (transparent); Style 3 (Square).
- 2.1.5 **Tempered glass:** 6 mm thick or 10 mm thick where indicated, complying with ANSI-297-1, Performance specifications and test methods for safety glazing in Buildings.
- 2.1.6 **Laminated safety glass:** Use 12 mm laminated glass at Reception Counter laminated layers of plate or float glass complying with CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass, refer to drawings for indicated. Provide openings in glazing for installation of glass stand-offs.
- 2.1.7 **Glass Stand-offs at Reception Counter:** Provide standard caps, vinyl washers, threaded steel, standoff base(spacer), 3/4" diameter at speaker port, polished chrome as manufactured by C.R. Laurence or equal.
- 2.1.8 **Mirrors, Silvered, Glass:** CAN/CGSB-12.5-M, clear or tinted, size(s) as indicated on Drawings, minimum 6 mm (1/4") thick float glass with process deposit of silver coats, copper coats and final protective seal, warranted for 10 years against deterioration of silvering.
- 2.1.8.1 Mirror Clips: No. 626 BZB sliding top channel clips and No. 627 BZB bottom channel slips bright nickel plated by Roll-It Inc.
- 2.1.8.2 Frame: Stainless steel, 0.64 mm (24 ga) thick minimum 9 mm (3/8") face and rounded corners.
- 2.1.8.3 Back: Galvanized metal back, minimum 0.49 mm (26 ga) overall thickness, zinc coating designation Z275 for mirrors up to 406 mm x 610 mm (16" x 24"), and minimum 0.64 mm (24 ga) overall thickness zinc coating designation Z275 for mirrors over 406 mm x 610 mm (16" x 24"). Provide with hidden mounting device for vertical or horizontal setting as required.
- 2.2 **GLAZING AND SEALING COMPOUND MATERIALS AND ACCESSORIES**
- 2.2.1 **Glazing Compound:** CAN/CGSB-19.2-M. Non hardening modified oil type. Colour to match adjacent surfaces unless indicated otherwise.
- 2.2.2 **Sealant Compound:** 1 component type, elastomeric chemical curing, CAN/CGSB-19.13-M, Class G-2-25-A-N. Colour to match adjacent surfaces unless indicated otherwise.
- 2.2.3 **Sealant Compound:** CAN/CGSB-19.24-M, multi-component chemical curing, Type 2 Class A. Colour to match adjacent surfaces.
- 2.2.4 **Sealant Compound:** CAN/CGSB-19.18-M, 1 component, silicone base solvent curing. Colour to match adjacent surfaces.

- 2.2.5 **Sealing and Bedding Compound, Acoustical:** CAN/CGSB-19.21-M
- 2.2.6 **Glazing Tape:** 440 polyisobutylene-butyl tape manufactured by Tremco Manufacturing Co. (Canada) Ltd., or 3M ribbon sealer butyl tape manufactured by Minnesota Mining and Manufacturing Co. Ltd.
- 2.2.7 **Gaskets:** ASTM C509 cellular, elastomeric, preformed, black.
- 2.2.8 **Glazing Splines:** (Neoprene) (polyvinylchloride) manufacturer's standard dry glazing splines to suit aluminum extrusions. Colour to match adjacent surfaces unless indicated otherwise.
- 2.2.9 **Glazing Points and Wire Spring Clips:** Corrosion resistant, manufacturer's standards.
- 2.2.10 **Spacer Shims and Setting Blocks:** Neoprene, Shore "A" Durometer hardness 70-90, 100 mm (4") long, wide enough to extend from fixed stop to opposite face of glass and of height suitable to provide adequate glazing "bite" for setting blocks. Neoprene, Shore "A" 40 to 50 Durometer hardness, of adequate thickness to provide correct glass to face clearance of at least 3 mm (1/8") for spacer shims.
- 2.2.11 **Primer Sealers and Cleaners:** To glass and plastic glazing manufacturer's standards.

2.3 **FABRICATION**

- 2.3.1 Label each light of glass and/or plastic glazing with registered name of product and weight and quality of glass and/or plastic glazing.
- 2.3.2 Check dimensions on Job Site before cutting materials.
- 2.3.3 Grind and chamfer edges of unframed glass and mirrors.
- 2.3.4 Ensure minimum bite or lap of glass and/or plastic glazing on stops and rabbets as recommended by glass and/or plastic glazing manufacturer.

3 **EXECUTION**

3.1 **INSTALLATION**

- 3.1.1 Conform to recommendation of Glazing Manual 1990, Flat Glass Marketing Association, except as specified herein.
- 3.1.2 Glaze hollow metal doors, screens, borrowed lights, windows and other work, scheduled to be glazed.
- 3.1.3 Install wired glass with wire parallel to sides of openings.
- 3.1.4 Check frames are plumb, within tolerance for size and joints, connectors, screws or bolt heads are effectively sealed.

- 3.1.5 Check compatibility of glazing materials and framing sealants with each other.
- 3.1.6 Do not field cut or abrade tempered glass.
- 3.1.7 Install glazing within temperature limits recommended by glazing manufacturer.
- 3.1.8 Check to ensure openings and stops to be painted have been primed before commencing installation.

3.1.9 Grind and chamfer edges of unframed glass. Ensure that bottom edge of glass which is exposed on the reception window is chamfered and ground where the edge is exposed at the transaction tray.

3.2 **WORKMANSHIP**

- 3.2.1 Ensure openings are free from moisture, frost, rust, dirt and foreign matter.
- 3.2.2 Remove protective coatings. Clean glass surface to receive sealant with clean cloth dampened with Xylol or 50-50 mixture of Acetone and Xylol. Wipe dry with clean, dry cloth.
- 3.2.3 Clean plastic glazing with cleaning agents and follow procedures recommended by glazing manufacturer.
- 3.2.4 Apply primer-sealer to contact surfaces.
- 3.2.5 Place setting block in accordance with manufacturer's instructions.
- 3.2.6 Install glass by resting on setting blocks. Ensure full contact and adhesion at perimeter. Do not impact glass against framing during installation.
- 3.2.7 Install removable stops without displacing tape, sealant or gasket.
- 3.2.8 Provide edge clearance of 3 mm (1/8") minimum.
- 3.2.9 Apply cap bead of sealant at exterior void. Apply sealant to uniform and level line, flush with sightline and tool or wipe with solvent to smooth appearance.
- 3.2.10 Apply tape to clean dry surface not more than 24 hrs prior to glazing. Do not remove release paper until glass is ready to be installed. Joints shall be squared and tightly and neatly butted. Do not overlap. Do not stretch tape to make it fit. Lightly daubed joints with compatible gunnable sealant to assure positive seal. Only joints in tape shall be at corners.
- 3.2.11 Lateral shims if not continuous shall be spaced uniformly at 450 mm (18") to 600 mm (24") centre.
- 3.2.12 For wet glazing both inside and outside, inside and outside shims shall be exactly same dimensions and exactly opposite each other.

3.3 INTERIOR GLAZING

3.3.1 Hollow Metal Doors and Screens:

3.3.1.1 Set glass in metals doors and screens on continuous setting block with 3 mm (1/8") gap between glazing stop glass and embed in glazing compound in accordance with and OBC requirements.

3.3.2 Dry Method-Tape/Tape:

3.3.2.1 Cut glazing tape to proper length and install against permanent stop projecting 1.5 mm (1/16") above sightline.

3.3.2.2 Place glazing tape on free perimeter of glass projecting 1.5 mm (1/16") above sightline.

3.3.2.3 Trim off excess tape to sightline.

3.3.3 Combination Method-Tape/Sealant:

3.3.3.1 Cut glazing tape to proper length and install against permanent stop projecting 1.5 mm (1/16") above sightline.

3.3.3.2 Fill gap between glass and applied stop with sealant to depth equal to bite of frame on glass to uniform and level line.

3.3.3.3 Trim off excess tape to sightline.

3.3.4 Wet Method-Compound-Compound:

3.3.4.1 Apply sealant to back and bottom of rabbet.

3.3.4.2 Bed glass in position with non hardening compound sealant.

3.3.4.3 Position and secure glass using spring wire or glaziers' clips. Apply face compound and trim sealant to slope away from light.

OR

3.3.4.4 Fill gaps between glass and stops with compound until flush with sightline and tool to smooth straight line.

3.3.5 Dry Method: Gaskets

3.3.5.1 Place gasket against permanent stop and position (glass) (acrylic) or (polycarbonate) sheet.

3.3.5.2 Apply removable stops. Install gaskets in frame channels.

3.3.6 Combination Method-Tape/Gasket:

3.3.6.1 Cut glazing tape to proper length and install against permanent stop.

3.3.6.2 Position glass.

3.3.6.3 Apply removable stops and install gaskets in frame channel.

3.3.7 Butt - Joint Glazing:

3.3.7.1 2 side glazing at head and sill use wet, dry, or wet/dry glazing systems.

3.3.7.2 Position glazing so that vertical edges are spaced slightly apart and seal with silicone sealant.

3.3.7.3 Grind vertical joint with slight kerf and polish for aesthetics.

3.4 Aluminum Framing – Interior windows and Screens

3.4.1 Install laminated glass at aluminum framing at Reception Counter.

3.4.2 Install stand-offs as recommended by manufacturer.

3.5 Mirrors – Washrooms and Room 147

3.5.1 Install mirrors where indicated on Drawings.

3.5.2 Mount plumb and level and accurately in position and secure rigidly in position.

3.5.3 Ensure back-up wall surface is thoroughly dry, smooth and firm and is primed or painted.

3.5.4 Provide space for air circulation and elimination of condensation between back of mirror and wall.

3.5.5 Install tamper proof mirrors according to manufacturer's directions.

3.5.6 Install mirrors without frames as follows with clips located uniformly 100 mm (4") from edge of mirrors.

3.5.7 Place felt or plastic pad between mirror and each clip.

3.5.8 Install mirrors with frames according to manufacturer's direction. Use concealed tamper proof fasteners.

3.6 FINISHING

3.6.1 Remove sealant and compound droppings from finished surface.

3.6.2 Periodically clean installed glass during construction to avoid permanent etching and staining.

3.6.3 Mark glass lights with temporary, easily removable large safety markings after glass installation. Maintain safety markings until final cleanup. Remove markings at time of final clean-up.

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- 3.6.4 Avoid storing materials adjacent to glass.
 - 3.6.5 Protect glass from other trades.
 - 3.6.6 At completion of Work, replace any damaged or broken glass provided under this Section with similar glass.

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 Section includes:

.1 Silicone glazing sealants.

1.3 RELATED SECTIONS

1.3.1 Division 07 air barrier section for framed opening transition assemblies and for compatibility requirements with air barrier components.

1.3.2 Section 07 92 00 "Joint Sealants" for general applications of joint sealants.

1.3.3 Section 08 80 00 "Glazing" for glazing sealants used in fabrication of glazing units.

1.4 SUBMITTALS

1.4.1 Product Data: For each type of joint sealant product specified, including:

.1 Preparation instructions and recommendations.

.2 Standard drawings illustrating manufacturer's recommended sealant joint profiles

1.4.2 Joint Sealant Schedule: Indicate joint sealant location, joint sealant type, manufacturer and product name, and color, for each application. Utilize joint sealant designations included in this Section.

1.4.3 Structural Sealant Joint Design: Submit manufacturer's certificate indicating that drawings, specifications, and design data provided by Architect have been reviewed and are approved as acceptable application of manufacturer's structural silicone sealant and comply with manufacturer's warranty requirements.

1. Shop Drawings: Show details of proposed structural sealant joints, indicating dimensions, materials, structural bite, glueline thickness, joint profile, and support framing.

1.4.2 Samples for Color Selection: For each joint sealant type.

1.4.3 Samples for Verification: For each exposed joint sealant product, for each color selected.

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

1.5.2 Installer Qualifications: A firm with minimum three years of experience installation of specified products in successful use on similar projects, including

a full-time on-site supervisor with a minimum of three years of experience installing similar work, able to communicate verbally with a contractor, architect, and employees.

1.5.3 Single Source Responsibility: Provide glazing sealants by a single manufacturer responsible for testing of Project substrates to verify compatibility and adhesion of joint sealants.

1.5.4 Preconstruction Manufacturer Laboratory Compatibility, Staining, and Adhesion Testing: Submit samples of each substrate or adjacent material that will be in contact with or affect joint sealants. Current manufacturer test data of products on matching substrates will be acceptable.

.1 Adhesion: Use ASTM C 719 and ASTM C 794 to determine requirements for joint preparation, including cleaning and priming.

.2 Compatibility: Use ASTM C 1087 to determine materials forming joints and adjacent materials do not adversely affect sealant materials and do not affect sealant color.

.3 Stain Testing: Use ASTM C 510, ASTM C 1248, or ASTM D 2203 to verify non-staining characteristics of proposed sealants on specified substrates.

.4 Pre-construction manufacturer laboratory testing is not required when sealant manufacturer can furnish data acceptable to Architect based on previous testing for materials matching those of the Work.

1.5.5 Preconstruction Field-Adhesion Testing: Prior to installing joint sealants, field test adhesion to joint substrates using ASTM C 1193 Method A. Verify adhesion is adequate. Modify joint preparation recommendations for failed joints and re-test. Submit written test report.

1.5.6 Mockups: Provide joint sealant application within mockups required in other sections identical to specified joint sealants and installation methods, installed by Project personnel.

1.6 **DELIVERY, STORAGE AND HANDLING**

1.6.1 Deliver caulking and sealing materials to Site in original, unopened containers with manufacturer's labels and seals intact. Labels shall identify manufacturer's name, brand name of product, grade and type, application directions and shelf life or expiry date of product.

1.6.2 Handle and store materials in accordance with manufacturer's printed directions. Store flammable materials in safe, approved containers to eliminate fire hazards.

1.6.3 Do not use caulking and sealing materials that has been stored for period of time exceeding maximum recommended shelf life of materials

1.7 **PROJECT CONDITIONS**

1.7.1 **Environmental Requirements:** Do not apply any sealant under adverse weather conditions, when joints to be sealed are damp, wet or frozen or when

at ambient temperatures below 4 deg C (40 deg F). Maintain minimum temperature of application during application and for 8 hours after application. Consult manufacturer for specific instructions before proceeding and obtain Consultant's approval.

1.8 WARRANTY

1.8.1 Special Manufacturer's Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that demonstrate deterioration, adhesive or cohesive failure, or penetration of water under normal use in joint applications approved by manufacturer, within warranty period specified.

1.8.2 Warranty Period for Silicone Sealants: Five years date of Substantial Completion.

1.8.3 Special Installer's Warranty: Original statement on Installer's letterhead in which Installer agrees to repair or replace joint sealants that demonstrate deterioration, adhesive or cohesive failure, or penetration of water within warranty period specified.

1.8.4 Warranty Period: Two years from date of Substantial Completion.

2 PRODUCTS

2.1 MATERIALS

2.1.1 **Silicone Glazing Sealants:** Single-Component, Non-sag, Non-Staining, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, Use NT; SWRI validated.

2. Basis of Design Product: **Tremco, Inc., Spectrem 2.**
3. Tensile Strength, ASTM D 412: 220 psi (1.5 MPa), at 100 percent elongation.
4. Tear Strength, ASTM D 624: 35 pli (6.1 kN/m).
5. Peel Strength, ASTM C 794: 30 pli (5.2 kN/m).
6. Hardness, ASTM C 661: 37 durometer Shore A, minimum.
7. Volatile Organic Compound (VOC) Content: 44 g/L maximum.
8. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
9. Staining, ASTM C 1248: None on concrete, marble, granite, limestone, and brick.
10. Color: As selected by Architect from manufacturer's standard line of not less than 10 colors.

2.1.2 JOINT SEALANT ACCESSORIES

2.1.2.1 Cylindrical Sealant Backing: ASTM C 1330, Type B non-absorbent, bi-cellular material with surface skin, or Type O open-cell polyurethane, as recommended by sealant manufacturer for application

2.1.2.2 **Bond Breaker Tape:** as recommended by sealant manufacturer.

2.1.2.3 **Joint Primer:** non-staining, suitable for substrate surfaces, compatible with joint forming materials and as recommended by sealant manufacturer.

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- 2.1.2.4 **Cleaning material:** as recommended by sealant manufacturer and acceptable to material or finish manufacturers for surfaces adjacent to sealed areas.

3 **EXECUTION**

3.1 **EXAMINATION**

- 3.1.1 Examine joint profiles and surfaces to determine if work is ready to receive joint sealants. Verify joint dimensions are adequate for development of sealant movement capability. Verify joint surfaces are clean, dry, and adequately cured. Proceed with joint sealant work once conditions meet sealant manufacturer's written recommendations.

- 3.1.2 Verify aluminum framing finish material is compatible with proposed sealant.

- 3.1.3 Do not apply sealant to masonry until mortar has cured.

- 3.1.4 Before any sealing work is commenced, test materials for indications of staining or poor adhesion.

3.2 **PREPARATION**

- 3.2.1 Structural Silicone Joint Design: Install sealant in joint design configuration recommended by manufacturer and as follows:

- .1 Glueline thickness: 1/4 inch (6 mm) minimum and not to exceed 1/2 inch (13 mm).
- .2 Structural Bite: 1/4 inch (6 mm) minimum and equal to or greater than glueline thickness.
- .3 Bite-to-Glueline Ratio: 3:1 or less.
- .4 Design and fill joint using manufacturer's recommended sealant application procedures.

- 3.2.2 Joint Surface Cleaning: Clean joints prior to installing joint sealants using materials and methods recommended by sealant manufacturer. Comply with ASTM C 1193.

- .1 Remove curing compounds, laitance, form-release agents, dust, and other contaminants.
- .2 Clean nonporous and porous surfaces utilizing chemical cleaners acceptable to sealant manufacturer.
- .3 Protect elements surrounding the Work of this section from damage or disfiguration. Apply masking tape to adjacent surfaces when required to prevent damage to finishes from sealant installation.

- 3.2.3 Clean porous surfaces such as concrete, masonry or stone by wire brushing, grinding or sandblasting as required to obtain clean and sound surfaces.

3.3 APPLICATION

3.3.1 Sealant and Primer Installation Standard: Comply with ASTM C 1193 and manufacturer's written instructions..

3.3.2 Joint Backing: Select joint backing materials recommended by sealant manufacturer as compatible with sealant and adjacent materials. Install backing material at depth required to produce profile of joint sealant allowing optimal sealant movement.

.1 Install joint backing to maintain the following joint ratios:

.1 Joints up to 1/2 inch (13 mm) wide: 1:1 width to depth ratio.

.2 Joints greater than 1/2 inch (13 mm) wide: 2:1 width to depth ratio; maximum 1/2 inch (13 mm) joint depth.

.2 Install bond breaker tape over substrates when sealant backings are not used.

3.3.3 Masking: Mask adjacent surfaces to prevent staining or damage by contact with sealant or primer.

3.3.4 Joint Priming: Prime joint substrates when recommended by sealant manufacturer or when indicated by preconstruction testing or experience. Apply recommended primer using sealant manufacturer's recommended application techniques.

3.3.5 Temporary Glass Support: Use temporary fasteners, clips, two-sided adhesive, and other means to retain glass panels while sealant is applied and allowed to cure as approved by the design professional..

3.3.5 Liquid Sealant Application: Install sealants using methods recommended by sealant manufacturer, in depths recommended for application. Apply in continuous operation from bottom to top of joint vertically and horizontally in a single direction. Apply using adequate pressure to fill and seal joint width.

.1 Tool sealants immediately with appropriately shaped tool to force sealants against joint backing and joint substrates, eliminating voids and ensuring full contact.

.2 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

.3 Tool exposed joint surface concave using tooling agents approved by sealant manufacturer for application.

3.3.6 Allow sealant to fully cure before adhesive is stressed. Use test specimens formed at time of sealant application to verify curing time. When cured, remove temporary glass supports.

3.3.7 Cleaning: Remove excess sealant using materials and methods approved by sealant manufacturer that will not damage joint substrate materials.

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- .1 Remove masking tape immediately after tooling joint without disturbing seal.
 - .2 Remove excess sealant from surfaces while still uncured

3.4 FIELD QUALITY CONTROL

- 3.4.1 Manufacturer's Field Services: Retain manufacturer's technical representative to observe sealant mockup installation, perform field pre-construction testing, and to issue reports of observations.

End of Section.

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.1.1 **Definitions:** Drywall - Gypsum Board.

1.2 RELATED SECTIONS

1.2.1 Installation of structural steel studs in Structural Drawings and Specifications

1.2.2 Installation of steel frames and frame anchor in gypsum board partitions:
Section 06 41 00 Carpentry and Millwork.

1.2.3 Firestopping and smoke seals: Section 07 84 00 Penetration Fire stopping.

1.2.4 Finish painting: Section 09 91 00 Painting and finishing.

1.2.5 Mechanical installations: Division 15, Mechanical.

1.2.6 Electrical installations: Division 16, Electrical.

1.3 REFERENCES

ASTM C11-10a	Standard Terminology Relating to Gypsum and Related building Materials and Systems
ASTM C36/C36M-03	<i>Standard Specification for Gypsum Wallboard</i>
ASTM C79/C79M-04	<i>Standard Specification for Treated Core and Non-Treated Core Gypsum Sheathing Board</i>
ASTM C475-02	Standard Specification for Joint compound and Joint Tape for Finishing Gypsum Board.
ASTM C645-04a	Specification for Non-structural Steel Framing Members
ASTM A653/A653M-04a	Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C754-04	Standard Specification for installation of Steel Framing Members to receive Screw Attached Gypsum Panel Board
ASTM C840-04a	Standard Specification for the Application, and Finishing of Gypsum Board.
ASTM C919-02	Standard Practise for Use of Sealants in Acoustical Application
ASTM C954-04	Standard specification for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in (0.84mm) to 0.112 in (2.84mm) in Thickness.
ASTM C1002-04	Standard Specification for Steel Self-Piercing, Tapping screws for The Application of Gypsum Panel Products or Metal Plaster Base to Wood Studs or Steel Studs
ASTM C1047-04	Standard Specification for Accessories for Gypsum Wallboard and Veneer Base.
ASTM C1177/C1177M-04e1	Standard Specification for Glass Mat Gypsum

ASTM C1178/C1178M-04e1	Substrate for Use as Sheathing. Standard Specification for Glass Mat Water-resistant Gypsum Backing Panel
ASTM C1280-04	Standard Specification for the Application of Gypsum Sheathing.
ASTM C1396/C1396M-04	Standard Specification for Gypsum Board (incorporates ASTM C36; C37, C79, C442, C630,C931, C960, C1395)
ASTM D 3273-00	Standard Tests Method for The Resistance to Growth of Mould on the Surface of Interior Coatings in The Environment Chamber
ASTM E84-05	Standard Test Method for Surface Burning Characteristics of Building Materials.
ASTM E90-04	Standard Tests Methods for Laboratory Measurement of Airborne Sound Transmission Loss of Buildings, Partitions and Elements.
ASTM E413 -04	Classification for Rating Sound Insulation
CAN/ULC-S101-M89	Standard Methods of Fire Endurance Tests of Building Construction and Materials
CAN/ULC-S102-M88	Surface Burning Characteristics of Building Materials and Assemblies
CAN/ULC-S702-97	Thermal Insulation, Mineral Fibre, for Buildings
ULC	Underwriters' Laboratories of Canada

1.4 **DELIVERY, STORAGE AND HANDLING**

- 1.4.1 Deliver materials to Site with manufacturers original labels intact. Do not remove wrappings until ready for use.
- 1.4.2 No outside storage permitted. Store in clean, dry area, off ground.
- 1.4.3 Stack gypsum board flat on level and dry surface without overhanging boards. Prevent sagging and damage to edges, ends and surfaces. Protect bagged products from excessive moisture or wetting.

1.5 **PROJECT CONDITIONS**

- 1.5.1 After installation, do not leave fibre-reinforced gypsum sheathing board exposed to weather conditions longer than 60 days.

2 **PRODUCTS**

2.1 **MATERIALS**

- 2.1.1 **Gypsum Board:** ASTM C36/C36M, paper faced; edges tapered or square rounded, to suit specific application, 1200 mm (48") wide sheets of maximum practical lengths to minimize end joints, regular, 15.9 mm mm (5/8") thick unless indicated otherwise on Drawings.

Acceptable Products
CGC Inc.
CertainTeed

Sheetrock Gypsum Board
Regular Gypsum Board

Georgia-Pacific Canada Inc. Toughrock Gypsum Board

2.1.2 **Gypsum Board Interior Fire Rated:** ASTM C36/C36M, Type X; edges tapered, 1200 mm (48") wide sheets of maximum practical lengths to minimize end joints, of type and thickness approved for required fire ratings, minimum thickness 15.9 mm (5/8").
Acceptable Products
CGC Inc. Sheetrock Firecode Core
CertainTeed Type X
Georgia-Pacific Canada Inc. Toughrock Fireguard X, Fireguard C

2.1.3 **Gypsum Board Exterior:** ASTM C1177, Type X; edges tapered, 1200 mm (48") wide sheets of maximum practical lengths to minimize end joints, of type and thickness approved for required fire ratings, minimum thickness 15.9 mm (5/8").
Acceptable Products
CGC Inc. Securoc Type X
CertainTeed GlasRoc
Georgia-Pacific Canada Inc. DensGlass Fireguard Sheathing Panel

2.1.4 **Gypsum Board Moisture Resistant, if required in wall assembly Fire Rated type:** ASTM C630/C1396, Type X; edges tapered, 1200 mm (48") wide sheets of maximum practical lengths to minimize end joints, of type and thickness approved for required fire ratings, minimum thickness 15.9 mm (5/8").
Acceptable Products
CGC Inc. Mould Tough
CertainTeed M2Tec
Georgia-Pacific Canada Inc. Toughrock Mold-Guard or Type X

2.1.5 **Abuse Resistant Fibre Reinforced Panel:** for high traffic wall applications, heavy duty, abuse resistant, multipurpose board, 15.9 mm (5/8") thickness equivalent to Type X gypsum board when tested in accordance with ASTM E119 and CAN/ULC-S101.
Acceptable Products
CertainTeed Extreme Abuse Resistant Drywall with M2Tech
CGC Inc. Sheetrock Brand AR Firecode X Panels

2.1.6 **Cement Board if required in wall assembly use Fire Rated type:** Fibreglass-Mat faced gypsum backing board for tile backer in wet areas, to ASTM C1178, Edges: square; Mould resistance: ASTM D3273 – 10, in a test as manufactured. Microbial Resistance: ASTM D6329, will not support microbial growth; Permeance: ASTM E96, not more than 1.0 perms when tiled; 5/8" Type X board per ASTM C1178 where required in Fire rated assembly
Acceptable Products
CertainTeed Diamondback or Diamondback Type X
Georgia-Pacific Canada Inc. DensShield Tile Backer
CGC Inc. Durock Cement Board

2.2 Metal Studs

- 2.2.1 For Gypsum Board:** ASTM C645, Galvanized sheet steel, minimum 0.59 mm thickness, zinc coating G90 (Z275); (25 gsg) (0.0247"), screwable with crimped web and returned flange, of depth shown.
- 2.2.2 For Abuse Resistant Panel:** ASTM C645, Galvanized sheet steel, minimum 1.01 mm thickness, zinc coating G90 (Z275) (20 gsg) (0.0396"), screwable with crimped web and returned flange. Minimum stud depth 88.90 mm (3-1/2") or deeper if so shown.
- 2.2.2.1** Provide knockout openings in web at 460 mm (18") o.c. to accommodate (if required) horizontal mechanical and electrical service lines and bracing.
- 2.2.3 Floor and Ceiling Partition Track for Gypsum Board:** Galvanized sheet steel, minimum 0.59 mm overall thickness zinc coating G90 (Z275); (25 gsg) (0.0247"), prepunched with square holes along Centre line and with minimum 30 mm (1-3/16") legs, top track having longer legs where required to compensate for deflection of structure above. Width to suit metal studs.
- 2.2.4 Furring Channels:** Galvanized sheet steel, minimum 0.59 mm overall thickness zinc coating G90 (Z275), (25 gsg) (0.0247") screw channels, 66.7 mm wide x 22.2 mm deep, (2-5/8" x 7/8").
- 2.2.5 Furring Channels For Abuse Resistant Fibre Reinforced Panel:** Galvanized sheet steel, minimum 0.59 mm overall thickness zinc coating G90 Z275, 20 gsg (0.0396") screw channels, 66.7 mm wide x 22.2 mm deep, (2-5/8" x 7/8").
- 2.2.6 Runner Channels:** Galvanized sheet steel, minimum 1.64 mm overall thickness zinc coating G90 (Z275) (16 gsg) (0.0635"), 38.1 mm (1-1/2") high with 19 mm (3/4") flanges, for primary furring member in suspended ceilings and as horizontal stiffeners or bracing in metal stud systems.
- 2.2.7 Hangers:** 4.8 mm (3/16") nominal diameter mild steel rod.
- 2.2.8 Tie Wire:** 1.60 mm nominal diameter (16 IW ga.) galvanized, soft annealed steel.
- 2.2.9 Corner Bead:** Galvanized steel sheet, minimum 0.59 mm overall thickness zinc coating G90 (Z275) [(25 gsg) (0.0247")], ASTM A653/653M, minimum width of flanges 28.6 mm (1-1/8") for 12.7 mm (1/2") thick board and 31.8 mm (1-1/2") for 15.9 mm (5/8") thick board.
- 2.2.10 Casing Bead:** Galvanized steel sheet, minimum 0.59 mm overall thickness zinc coating G90 (Z275) (25 gsg) (0.0247"), ASTM A653/653M, designed for finishing with joint compound.
- 2.2.11 Drywall Reveal Trims at Millwork:** D-300 Drywall reveal trim by Bailey Metal Products or equal. A=1/2"; B=1/2".

- 2.2.12 **Gypsum Board Screws:** to ASTM C1002; Self-drilling, self-tapping gypsum board screws, 25.4 mm (1") long #6 for single layer application, 41.3 mm (1-5/8") long #7 for double layer application.
- 2.2.13 **Fasteners for Fibre-Reinforced Gypsum Board or Sheathing:** Galvanized; 11 ga roofing type of exterior sheathing with minimum 11 mm (7/16") dia head.
- 2.2.14 **Fasteners for Structural Steel Studs:** Galvanized; powder actuated fasteners suitable for gauge of steel specified in structural section.
- 2.2.15 **Control Joint:** zinc control joint No. 093 for interior applications, provides stress relief to control cracking. 16 mm depth of corrosion-resistant galvanized steel to suit depth of gypsum board at partitions and ceilings.
- 2.2.16 **Laminating Compound:** asbestos-free, as recommended by manufacturer.
- 2.2.17 **Joint Cement, Tape, Topping & Compound to ASTM C475, Accessories to ASTM C1047:** As recommended by gypsum board manufacturer.
- 2.2.18 **Sponge Tape:** Self-sticking adhesive on 1 side, closed cell neoprene sponge tape.
Acceptable Products
Jacobs and Thompson Inc. Perma-Stik 1220X
- 2.2.19 **Adhesive:** Manufacturer's standard, multi-purpose construction adhesive.
- 2.2.20 **Sound Attenuation Blankets:** of sufficient thickness to meet required STC rating for sound-proofed partitions.
Acceptable Products
Rockwool Safe'n'Sound
- 2.2.21 **Acoustic Sealant:** Non-hardening, Tremco Acoustical Sealant by Tremco Ltd.
- 2.2.22 **Elastomeric Sealant:** as recommended by manufacturer of fibre-reinforced gypsum sheathing board.
- 2.2.23 Tuff-Hide Primer: as manufactured by CGC Inc. for use on abuse, water & mould resistant interior panels, skim coat and primer coat to be installed in a single spray application. For use on all Category 4 Heavy/Extreme Duty Walls.
Applicator of product must have at least 5 years experience in the installation of spray applied plaster or its equivalent and must be qualified to undertake this work. Qualifications and installations must be provided if requested by the Consultant. Under no circumstance will an inexperienced installer be used for this work.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Temporary heat is provided under Section 01 51 00, Temporary Facilities and Controls. Carry out work of this Section only when temperature is maintained and controlled in range of 13 deg C to 21 deg C (55 deg F to 70 deg F), for at least 24 hrs before installing gypsum board and is so maintained until joint

cement and adhesives are cured.

- 3.1.2 Provide adequate ventilation to eliminate excessive moisture before commencing and during work to ensure proper drying of joint filler and adhesive. Do not force dry adhesive and joint treatment.

- 3.1.3 Examine substrate for compliance with applicable requirements, installation tolerances and other conditions affecting installation of fibre-reinforced gypsum board or sheathing. Do not proceed until unsatisfactory conditions have been corrected. Beginning of installation shall indicate acceptance of substrate conditions.

3.2 PREPARATION

- 3.2.1 Allow fibre-reinforced gypsum underlayment to acclimate for 48 hours on Site prior to installation.

3.3 INSTALLATION

- 3.3.1 Conform to ASTM C840 for the application of interior gypsum board, except as specified otherwise herein.

- 3.3.2 Cooperate with mechanical, electrical and other trades to accommodate fixtures, fittings and other items in gypsum board areas.

- 3.3.3 Install casing bead and sponge tape where gypsum board abuts materials other than itself and acoustic tile ceilings including at exterior door and window frames, where juncture is not concealed with trim; or elsewhere where indicated on Drawings. Unless indicated otherwise, use tape 3 mm (1/8") narrower than casing bead to provide recess at exposed side. Compress tape by 25%.

- 3.3.4 If gypsum board abuts another gypsum board surface and joint is shown not to be taped and filled or otherwise covered, make juncture same as above.

- 3.3.5 Install sponge tape between gypsum board partition or furring framing, where such framing abuts exterior door or window frame.

- 3.3.6 Install sponge tape between floor and gypsum board partition track. Tape shall be either full width or 1 strip 9.5 mm (3/8") wide on each side of framing member.

- 3.3.7 Erect casing beads plumb or level with minimum number of joints. Do not use scrap pieces.

- 3.3.8 Where additional supports are not installed on electrical fixtures located in ceiling, provide written confirmation to Division 16 Electrical, when requested by Consultant, that suspended ceiling is capable of supporting weight of lighting fixtures, and other electrical fixtures required by Division 16, Electrical.

- 3.3.9 Allow for deflection at top of partitions to avoid transmission of structural loads to framing system.

- 3.3.10 Provide partitions of thickness indicated on Drawings.

3.3.11 Provide adequate reinforcing for framing to receive wall mounted fixtures and vanities.

3.3.12 Firmly fasten panel to framing members without cutting surface paper or fracturing core. Ensure panel joints are aligned. Lay out panels with maximum spacing between panels not to exceed 6 mm (1/4").

3.4 **Wall Furring**

3.4.1 Apply metal furring members vertically to masonry and concrete walls at 600 mm (24") o.c. or less as required to suit insulation sizes. Fasten members 600 mm (24") o.c. through flanges.

3.4.2 Shim furring members as required to present true, plumb line for application of gypsum board.

3.4.3 Locate furring members not more than 50 mm (2") away from openings, interior corners, intersections, frames, control joints and similar items.

3.4.4 Use 20 ga. metal furring where abuse resistant board is specified at masonry and concrete walls.

3.5 **Stud Partitions**

3.5.1 Install steel studs in accordance with ASTM C754 unless specified otherwise in this specification.

3.5.2 Provide accurately aligned partition tracks at top and bottom of partitions. Secure at 600 mm (24") o.c.

3.5.3 Erect studs vertically in partition tracks at 400 mm (16") o.c. and not more than 50 mm (2") abutting walls, openings and each side of corners.

3.5.4 Place attachment clip over main/cross tee from top. Line up pre-drilled hole on clip with hole on main/cross tee and screw clip to main/cross tee with 12 mm (1/2") wafer screw.

3.5.5 Screw through pre-drilled holes in attachment clip into top track of stud partition or glazed partition. Do not screw through ceiling grid.

3.5.6 Coordinate installation of attachment clip with Section 09 51 00, Acoustic Ceilings. Do not damage ceiling grid system during installation of these clips.

3.5.7 Extend studs on each side of openings from floor to ceiling or structure above, whichever is indicated.

3.5.8 Locate 2 framing members on each side of framed openings. Frame over and below openings and runner sections at least 150 mm longer than rough openings. Cut ends to fit bend wed up and screw anchor to adjacent studs. Install cut to length intermediate vertical studs in same manner and spacing as wall studs over such framed openings. Securely anchor studs to head and jamb anchor clips of door frames by blot or screw attachment. Insert intermediate

studs above and below channels to support gypsum board.

- 3.5.9 Install horizontal runner at top and bottom of rough opening in glazed partitions.
- 3.5.10 Install cut to length intermediate vertical studs, in same manner and spacing as wall studs, over door frames, above, and below other openings.
- 3.5.11 Where studs extend over 3600 mm (12'-0") in height provide horizontal bracing spaced approximately 2400 mm (8'-0") o.c. vertically and provide double studs at each side of door frames.
- 3.5.12 Size, brace and reinforce studs as necessary to provide sturdy, rigid partitions to heights and lengths required.
- 3.5.13 Securely anchor partition track to building structure and make 12 mm (½") allowance in partition studs for deflection of structure above to avoid transmission of structural loads on partitions. Do not secure studs or gypsum board to top track.
- 3.5.14 Where horizontal runs of service lines are to be installed, arrange with applicable trades to have lines installed prior to gypsum board application.

3.6 **Ceiling Furring**

3.6.1 **Hangers:**

- 3.6.1.1 Hangers for suspended gypsum board ceilings, bulkheads and duct furring shall support grillage independent of walls, columns, pipes, ducts, conduit and similar components. Erect hangers plumb and securely anchor to structure.
- 3.6.1.2 Where hangers are suspended from unfilled steel deck make holes through both sides of deck troughs and pass hanger through and down both sides of troughs. Ensure that ends of hangers are wrapped around vertical portion of hanger rod at insert.
- 3.6.1.3 Alternatively, in both composite and unfilled steel deck, hangers may be dropped through punched holes in bottom of deck troughs before deck is filled or covered, provided they are suitably and securely anchored at top.
- 3.6.1.4 Space hangers at maximum 1200 mm (4'-0") o.c. along runner channels and not more than 150 mm (6") from ends to support weight of ceiling and superimposed loads such as lighting fixtures, diffusers and grilles.
- 3.6.1.5 Where ducts are large or where combination of ducts, or combination of ducts and other items interfere so that hanger spacing exceeds 1200 mm (4'-0"), increase size of main runner channels and hangers accordingly to sustain increased loading and span.

3.6.2 Runner Channels:

- 3.6.2.1 Space runner channels at maximum 1200 mm (4'-0") o.c. and not more than 150 mm (6") from boundary walls, interruptions of continuity and changes in direction.
- 3.6.2.2 Run channels at right angles to structural framing members.
- 3.6.2.3 Where splices are necessary, lap members at least 200 mm (8") and wire each end with minimum double strand of tie wire. Avoid clustering or lining up splices. Provide hanger within 150 mm (6") of splice.
- 3.6.2.4 Attach channels to rod hangers by bending hanger sharply under bottom flange of runner and securely wire in place with saddle tie.

3.6.3 Cross Furring

- 3.6.3.1 Erect furring channels at right angles to runner channels.
- 3.6.3.2 Space furring channels at 600 mm (24") o.c. and not more than 150 mm (6") from boundary walls, interruptions in ceiling continuity and change in direction.
- 3.6.3.3 Secure furring channels to each support with double strand of tie wire or with clip approved by manufacturer of furring components. Splice joints by nesting and tying channels together.
- 3.6.3.4 Furring channels shall be level to maximum tolerance of 3 mm (1/8") over 3600 mm (12').

3.7 Ceiling Bulkhead

- 3.7.1 Fur for gypsum board faced vertical bulkheads within and at termination of ceilings.
- 3.7.2 Fur above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as shown.
- 3.7.3 Install studs vertically at 450mm (18") o.c., aligning stud openings. Secure studs to tracks using pinching tool or screws. Brace stud framing to form a rigid system.
- 3.7.4 Construct corners using a minimum of three studs.
- 3.7.5 Provide extended leg ceiling runners as required to accommodate deflection.

3.8 Gypsum Board - Single Layer

3.8.1 Ceilings:

- 3.8.1.1 Apply gypsum board to metal furring with screws.

3.8.1.2 Erect board with long dimension parallel to supports. Locate end joints over supporting members.

3.8.1.3 Space screws at 200 mm (8") o.c.

3.8.2 Partitions:

3.8.2.1 Apply gypsum board to metal studs with screws.

3.8.2.2 Erect board with long dimension parallel to supports. Locate end joints over supporting members.

3.8.2.3 Locate vertical joints at least 300 mm (12") from jamb lines of openings.

3.8.2.4 Space screws at 200 mm (8") o.c. at board edges and 300 mm (12") o.c. on board field.

3.8.3 Ceiling and Partition Fasteners:

3.8.3.1 Perimeter screws shall be not less than 10 mm (3/8") or more than 13 mm (1/2") from edges and ends and shall be opposite screws on adjacent boards.

3.8.3.2 Drive screws with power screw gun and set with countersunk head slightly below surface of board.

3.8.4 Joints:

3.8.4.1 Finish all joints.

3.9 Fire Rated Construction

3.9.1 Provide fire rated enclosures, separations, and assemblies as indicated on the drawings conforming to requirements of Authorities Having Jurisdiction

3.10 Fibre-Reinforced Gypsum Board and/or Sheathing: Install panels where indicated on Drawings and in accordance with manufacturer's recommendations.

3.10.1 Maintain min 9.5 mm (3/8") space between perimeter of panels and fasteners. Provide no of fasteners, fasteners length and spacing in accordance with manufacturer's recommendations to suit Site conditions and applications.

3.10.2 Stagger end joints. Stagger joints on opposite of wall assembly on alternate framing members.

3.10.3 Install panels horizontally or vertically at Contractor's choice.

3.10.4 If sheathing board will be exposed to elements prior to application of weather barrier finish, seal all joints including vertical joints abutting over framing members and cut edges with elastomeric sealant. Seal all fastener heads.

3.11 Sound Rated Partitions

3.11.1 Where indicated on Drawings, provide soundrated partitions with minimum Sound Transmission Class as noted on the Partition Types.

3.11.2 Install sound rated partitions in locations indicated on Drawings to meet required minimum STC rating. Gypsum board shall be applied on both sides of sound-proofed partitions. Follow manufacturer's details and recommendations.

3.11.3 Apply minimum 12 mm (½") diameter bead of acoustic sealant continuously around periphery of each face of partition to seal gypsum board/structure junction where partitions abut fixed building components. Add additional, seal full perimeter of cut-outs around electrical boxes, ducts or similar penetration in partitions where perimeter sealed with acoustic sealant.

3.12 Control Joints

3.12.1 Install control joints where located in ceiling and walls where located on drawings. Staple-applied to panel face. Where fire and sound partitions are indicated a seal must be provided behind the control joint.

3.13 Pressed Steel Frames

3.13.1 Install pressed steel frames where they occur in gypsum board partitions.

3.13.2 Anchor frames securely to studs using minimum of 3 anchors per jamb for jambs up to 2100 mm (7') high and minimum of 4 anchors per jamb for jambs over 2100 mm (7') high.

3.14 Finishing

3.14.1 Level of Finishing to ASTM C840

3.14.1.1 **Level 0:** no taping, finishing or corner beads are required.

3.14.1.2 **Level 1:** All joints and angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.

3.14.1.3 **Level 2:** All joints and angles shall have tape embedded in joint compound and have one separate coat or joint compound wiped with joint knife and leaving a thin coating over the tape and fastener heads. Accessories shall be covered by one coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges shall be acceptable.

3.14.1.4 **Level 3:** All joints and angles shall have tape embedded in joint compound and two separate applications of joint compound over all joints, angles and fastener heads. Accessories shall be covered with two separate coats of joint compound. Joint compounds shall be smooth and free of tool marks and ridges. The prepared surface shall be covered with a drywall primer prior to the application of the final decoration.

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- 3.14.1.5 **Level 4:** All joints and angles shall have tape embedded in joint compound. and have three separate coats of joint compound over all joints, angles and fastener heads. Accessories shall be covered with three separate coats of joint compound. All joint compounds shall be free of tool marks and ridges. The prepared surface shall be covered with a drywall primer prior to the application of the final decoration.
- 3.14.1.6 **Level 5:** Equal to level 4 and in addition, a skim coat shall be applied. Excess material shall be immediately sheared off, leaving a film covering the paper. The prepared surface shall be covered with a drywall primer prior to the application of the final decoration.
- 3.14.2 Do filling either manually, using tools of trade, or by mechanical taping and filling machine of proven efficiency.
- 3.14.3 Apply joint filler, tape and topping cement according to manufacturer's directions.
- 3.14.4 Finished work shall be smooth, seamless, plumb, true and flush, having square, neat corners.
- 3.14.5 Drive home fasteners protruding above panel surface. Fill fastener depressions.
- 3.14.6 Apply continuous coat of joint compound to fill channel formed by tapered edges of panels. Center tape and lightly press to embed in compound. Apply thin coat over tape.
- 3.14.7 Apply joint compound over butt joints and embed tape in manner similar to tapered joint. Provide sufficient quantity of compound under the tape to ensure adequate bond.
- 3.14.8 Apply coat of joint compound to corner and casing beads.
- 3.14.9 Fold tape to form 90° angle. Apply joint compound to both sides of corner. Embed in taping compound.
- 3.14.10 After joint compound has dried completely. Apply additional coats of finishing compound to obtain required level of finish. Provide recommended sanding between coats as recommended by manufacturer.
- 3.15 **Installation: Tuff-Hide Primer-Surfacer**
- 3.15.1 Substrate must be sound, dry, clean and free of oil, grease, mildew and efflorescence. During and after application, avoid drafts and maintain 13 degC. (55 deg.F) minimum product, air and surface temperature until surface is dry.
- 3.15.2 Interior panels, substrate must be reviewed by CGC representative prior to application of primer to ensure that interior panels have been properly installed and taped prior to installation of primer.

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- 3.15.3 Treat all joints, fasteners, and accessories with a recommended CGC/Synko joint treatment product. Fill all nicks, voids, and gouges with joint compound. A minimum Level 4 wallboard finish must be provided as per recommendations outlined in GA-214, "Recommended Levels of Gypsum Board Finish", or ASTM C-840.
 - 3.15.4 Mix product as per written recommendations of manufacturer.
 - 3.15.5 Airless spray application only as per written recommendations of manufacturer. In all applications a wet film thickness in excess of 0.51 mm (20mils) is not recommended. Use of wet film thickness gauge to ensure proper application thickness and maximum performance.
 - 3.15.6 The use of professional equipment that meet or exceeds the written requirements of the manufacturer must be used. Ensure that the airless sprayer, hoses, guns and other related equipment are clean and in good working condition prior to application. The use of faulty equipment will result in reapplication until satisfactory application has been attained as per recommendations of the manufacturer.
 - 3.15.7 Touch-up damaged surfaces as per written recommendations by manufacturer.
 - 3.15.8 Wipe up drips and spills immediately with damp cloth, ensure that adjacent surfaces are well protected and unaffected by application of primer.
 - 3.16 Cutting and Patching**
 - 3.16.1 Do cutting, patching and making good as required by installation of work of other Sections and co-operate closely with these Sections to assure satisfactory finish.

End of Section.

1. GENERAL

1.1. Conform to Sections of Division 1 as applicable.

1.2.

1.3. RELATED SECTIONS

1.3.1. Sealant at junction of lavatory splashback and urinals and ceramic wall tile: Section 07 92 00, Sealants.

1.3.2. Gypsum, cement board or fibre-reinforced cement flat panel to receive tile finish: Section 09 29 00, Gypsum Board.

1.3.3. Toilet and bath accessories: Section 10 80 00, Washroom Accessories.

1.3.4. Solid Surface Countertops: Section 12 36 61 Quartz Countertops.

1.4. REFERENCES

ANSI A108.4, ANSI A118.1
ANSI 108.1-1985
ASTM C207-91 (1997)

CGSB 71-GP-22M-78

CGSB 71-GP-30M-79

CAN/CGSB-75.1-M88
CAN/CSA-A5-98
CSA A179 -94(R1999)
TTMAC

ANSI A118.3, ANSI A118.4, all part of
Installation of Ceramic Tile
Specification for Hydrated Lime for
Masonry Purposes
Adhesive, Organic, for Installation of
Ceramic Wall Tile
Adhesive, Epoxy and Modified Mortar
Systems, for Installation of Quarry
Tiles
Tile, Ceramic
Portland Cement
Aggregate for Masonry Mortar
Terrazzo Tile & Marble Association of
Canada

1.5. SUBMITTALS

1.5.1. Samples

1.5.1.1. Submit 4 samples of each colour, texture, size and pattern of tile.

1.5.2. **Maintenance Manual:** Submit 3 copies of maintenance manual issued by TTMAC in accordance with Section 01 33 00, Submittals.

1.6. PROJECT CONDITIONS

1.6.1. **Environmental Requirements:** Maintain air and structural base temperatures at ceramic tile installation area above 12 deg C (54 deg F) for 48 hrs before, during, and 45 hrs after installation.

1.6 WASTE MANAGEMENT AND DISPOSAL

- 1.6.1 Separate waste materials for reuse and recycling in accordance with Section 01 35 00 –Environmental Protection Requirements.
- 1.6.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- 1.6.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling.
- 1.6.4 Fold up metal banding, flatten and place in designated area for recycling.

2. PRODUCTS

2.1. General

2.1.1. Tile

- 2.1.1.1. Porcelain Floor Tile: Tests performed, results conform to
 - .1 Water Absorption ISO 10545-3
 - .2 Dynamic Co-efficient of Friction ANSI A137.1:2012
 - .3 Breaking Strength ISO 10545-4
 - .4 Deep Abrasion Resistance ISO 10545-6
 - .5 Chemical Resistance Cahier CSTB 3735
 - .6 Frost Resistance ISO 10545-12

12" x 24", Time 2.0 36T28NR Carbon Neutral, by Centura
Where ceramic base tile is specified: 4" high x 24", use FT-1

- 2.1.1.2. Wall Tile: WT-1
Not Used.

- 2.1.1.3. Wall Tile: Lumen, as supplied by Olympia Tile.
WT-2
Colour: Pearl: GV044M (10" x 30")

- 2.1.1.4. Wall Tile: Lumen, as supplied by Centura.
WT-3,
Colour Pearl Lux: GV044L 25 x 75 (10" x 30")

- 2.1.1.5. Wall Tile: Lumen, as supplied by Centura.
WT-4,
Colour: Pearl Matita: GVM44M 2 x 75 (0.8" x 30")

- 2.1.1.6. Wall Tile (backsplash): Colour and Dimensions Collection, as supplied by Olympia Tile.
WT-5
Colour: Arctic White (2-1/8" x 8-1/2"), QT.CD.ARW.0208.BR

-
- 2.1.1.7. Shower Ceiling:
WT-6 4.25" x 4.25", Colour and Dimensions Collection
by Olympia, Colour: Arctic White, Glossy. QT.CD.ARW.0404.BR
- 2.1.2. Waterproofing membrane at Shower (floor and wall): Schluter – KERDI waterproofing membrane, sheet applied polyethylene waterproofing membrane for shower walls and floors, KERDI-BAND, in 5" widths to seal butt joints or corner joints, as manufactured by Schluter Systems (Canada) Inc.
- .1 Provide Schluter Kerdi-Board-SN 12 in. x 12 in. Shower Niche located at Barrier Free shower.
- 2.1.3. **Mortars and Adhesives:** Refer to Section 01351 for specific requirements for low emitting materials – Adhesives. Use of following mortars or adhesives is Contractor's choice, subject to restrictions stated and Site conditions, except where epoxy or acid resistant mortar and grout is required.
- 2.1.3.1. Thin Set Mortar: ANSI 118.1, or ANSI 118.4 (CGSB 71-GP-30M for Type 2) except where epoxy adhesive required:
- For glazed and unglazed wall and floor tile, water absorption class MR 2: Kerabond or Ultraflex II by Mapei or No. 52 Versatile by Flextile.
 - For vitreous (glazed) floor and wall tile, with less than 0.5% absorption; and size 300 mm x 300 mm or larger; water absorption class MR 1: Kerabond/Keralastic by Mapei or No. 52 Versatile by Flextile.
 - For high absorption glazed wall and ceiling tile, with water absorption class MR 4: Kerabond by Mapei.
- OR**
- 2.1.3.2. Latex Modified Thin Set Mortar: For conditions above use latex mortar conforming to ANSI A108.4, except where epoxy adhesive is required.
- OR**
- Kerabond mixed with Keralastic by Mapei.
- OR**
- 2.1.3.3. Mortar Bed: Mixed on Site of following components:
- Cement: CAN/CSA-A5-M, Type 10 Portland.
 - Sand: CSA A179.
 - Hydrated Lime: To ASTM C207, Type S.
 - Latex or Acrylic Additive: Formulated for use in Portland cement mortar, by Acrylic Mortar Additive by Flextile or Planacrete 50 by Mapei

- Water: Potable, free of minerals detrimental to mortar and grout mixes.

OR

2.1.3.4. **Adhesives:**

- Organic Adhesive: CGSB 71-GP-22M, Type 1 for intermittent wet areas, Duoflex #90, or #99 by Flextile or Ultramastic 1 by Mapei, Econobond #93 by Flextile or except where epoxy is required.
- Epoxy Adhesive: ANSI A118.3, CGSB 71-GP-30M Type 1 (100% solids epoxy), Kerapoxy by Mapei or Flex-Epoxy 100 by Flextile.

OR

- 2.1.4. **Grouts:** Floor and Wall, Polymer Modified, Fast-setting Grout: Ultracolor® Plus FA grout, as manufactured by Mapei or equal.

2.2. **MIXES**

2.2.1. **Mortar Bed**

- 2.2.1.1. Scratch Coat: 1 part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand, 1 part water. Adjust water volume depending on water content of sand. Use as little water as possible to obtain a stiff mix.
- 2.2.1.2. Slurry Bond Coat: Cement and water mixed to creamy paste. Latex additive may be included.
- 2.2.1.3. Mortar Bed for Floors: 1 part Portland cement, 4 parts sand, 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
- 2.2.1.4. Mortar Bed for Walls and Ceilings: 1 part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand and 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
- 2.2.1.5. Levelling Coat: 1 part cement, 4 parts sand, 1 part water, including minimum 1/10 part latex additive (as per manufacturer's instructions) such as Level-Cure by C-Cure.
- 2.2.1.6. Bond or Setting Coat: 1 part cement, 1/3 part hydrated lime, 1 part water.
- 2.2.1.7. Measure mortar ingredients by volume.
- 2.2.2. **Thin Set Mortar:** Mix to manufacturer's instructions.

2.2.3. **Organic Adhesive:** Pre-mixed.

2.2.4. **Accessories**

2.2.4.1. Divider Strips: 5 mm thick aluminum with embedded leg to depth as required to suit installation.

2.2.4.2. Edging for Tile at Porcelain Tile base: 2150CA, satin anodized aluminum as manufactured by Benguard.

2.2.4.3. Tile edge trim: for wall where ceramic wall tile terminates, or at tiled jamb conditions, outside tiled corners, and at shower niche, Rondec – DB, material – colour coated aluminum, thickness to suit tile thickness, as manufactured by Schluter Systems or equal. Colour to match tile and must be approved by Consultant.

2.2.4.4. Transition at Porcelain Tile and edges where floor coverings at lower elevations: Reno-U as manufactured by Schluter. Description: profile with sloped exposed surface, 5/32" (4 mm) tall leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer. Material and Finish: AE – Satin anodized Aluminum, Height as required.

3. **EXECUTION**

3.1. **INSTALLATION**

3.1.1. Wipe back side of tile with slightly damp towel or sponge to remove dust, dirt and/or residue. Apply back-buttered thin coat of fresh mortar or adhesive approximately 2 mm (1/16") thick to back side of each tile immediately before laying into freshly applied wet notch trowel applied mortar bond coat. Provide 100% mortar coverage at perimeter edges and corners.

3.1.2. Apply tile and backing materials to clean and sound surfaces and in accordance with setting system specified.

3.1.3. Remove paper facing after setting and adjust tiles where applicable.

3.1.4. Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Make cut edges smooth and even.

3.1.5. Maximum Surface Tolerance: 1:800.

3.1.6. Make joints between tiles uniform and approximately 1.5 mm (1/16") wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.

3.1.7. Lay out tiles so perimeter tiles are minimum 1/2 size.

-
- 3.1.8. Lay out floor tile using ashlar pattern and to patterns as indicated on drawings for tile and mosaic wall tiles.
 - 3.1.9. Lay out ceiling tile in Showers using diagonal pattern. (45° angle)
 - 3.1.10. Sound tiles after setting and replace hollow sounding units to obtain full bond.
 - 3.1.11. Make internal angles square and external angles (rounded).
 - 3.1.12. Make coved base of the same material as floor tile.
 - 3.1.13. Use round trim at termination of wall tile panels, except where panel abuts projecting or right angle surface or flush adjacent surface.
 - 3.1.14. Install divider strips at junction of tile flooring and dissimilar material.
 - 3.1.15. Allow minimum 24 hours after installation of tiles before grouting. Prepare and apply grout to manufacturer's instructions.
 - 3.1.16. Clean installed tile surfaces after grouting cured.
 - 3.1.17. Make control joints at max 6 m (20') in each direction or follow grid lines of building where indicated. Make joint width same as tile joints. Fill control joints with sealant in accordance with manufacturer's recommendations. Keep building expansion joints free of mortar or grout.
 - 3.1.18. **Setting System**
 - 3.1.18.1. Wall Tile: Install in accordance with TTMAC detail 303W-2002, 304W-2002, 305W-2002 (Shower).
 - 3.1.18.2. Floor Tile: Install in accordance with TTMAC detail Detail B, 311F-2002.
 - 3.1.18.3. Shower Tile: Install in accordance with TTMAC detail 319SR-2002, Detail B 315C-2002(ceiling tile). **Lay tile on ceiling at 45° angle. Layout tile such that no tile is less than ½ tile.**
 - 3.2. **INSTALLATION: Edge Trim**
 - 3.2.1. Select edge trim according to tile thickness.
 - 3.2.2. Trowel dry-set mortar over the area where profile is to be placed. If edge trim is used at outside wall corners, finish tiling one wall first; then apply dry-set mortar to the corner area of the second wall.
 - 3.2.3. Press the perforated anchoring leg of trim into the mortar and align.

- 3.2.4. Trowel additional dry-set mortar over the perforated anchoring leg to ensure full coverage and support of the tile edges; fill the cavity with grout or setting material.
- 3.2.5. Set the tile to the integrated joint spacer, which ensures a uniform joint of 1/16" - 1/8" (1.5 - 3 mm). When installing the stainless steel profiles, leave a joint of approximately 1/16" - 1/8" (1.5 - 3 mm).
- 3.2.6. Solidly embed adjacent tiles and adjust flush with the profile's upper edge.
- 3.2.7. Fill the joint completely with grout or setting material.
- 3.2.8. Work with materials and tools that will not scratch or damage sensitive surfaces. Setting materials must be removed immediately, especially on aluminum.
- 3.2.9. Provide corner trim for inside and outside corners.

3.3. Installation: Waterproofing Membrane at Shower

- 3.3.1. Install waterproofing membrane in conformance to manufacturer's written instructions. Ensure substrate is clean, even for application of thin-set mortar.
- 3.3.2. Overlap edges of the waterproofing membrane by 5 cm or by abutting the edges and covering the joint with Kerdi-Band.
- 3.3.3. For floor/wall connections, use Kerdi-Band.
- 3.3.4. For tile installations, apply unmodified thin-set mortar to exposed Kerdi surface and install the tiles ensuring full coverage.
- 3.3.5. Install waterproofing membrane at shower niche at barrier free shower as per manufacturer's instructions.

3.4. PROTECTION

- 3.4.1. Prohibit all traffic in work areas during installation and for 72 hour after installation of tile.

End of Section

1. **GENERAL**

1.1 Conform to Sections of Division 1, as applicable.

1.1. **RELATED SECTIONS**

1.1.1. Mechanical fixtures under Division 23, Mechanical.

1.1.2. Electrical fixtures under Division 26 Electrical.

1.1.3. Supply and installation of attachment clips to exposed tee grid system:
Section 09 29 00, Gypsum Board.

1.2. **REFERENCES**

ASTM C635-17	Specification for The Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636-13	Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E1264-14	Standard Classification for Acoustical Ceiling Products
ASTM E84-18	Standard Test Method for Surface Burning Characteristics of Building materials

1.3. **SHOP DRAWINGS**

1.3.1. Submit shop Drawings in accordance with Section 01 33 00 Submittals.

1.3.2. Submit manufacturer's **environmental product declaration** for
inclusion in the Close-out Submittals.

1.4. **SAMPLES**

1.4.1. Submit samples of acoustical panels for approval prior to ordering.

1.4.2. Submit samples of each type of ceiling suspension system.

1.5. **QUALITY ASSURANCE**

1.5.1. **Regulatory Requirements:** Complete ceiling assemblies including panel and
suspension system shall be fire rated and labeled in accordance with ULC
Design number noted on Drawings.

1.6. **MAINTENANCE**

1.6.1. **Extra Materials**

1.6.2. **Spare Products:** Supply 2% extra lay-in panels and grid components, packaged in acceptable cardboard cartons, for future repairs and store where directed.

2. PRODUCTS

2.1. **Suspension Systems:** manufactured by CGC or Armstrong and to following specifications. Maximum deflection 1/360 of span tested to ASTM C635.

2.1.1. **Basic Steel Material and Finish:** Commercial quality cold rolled steel 0.179" (26 ga) thick, galvanized to zinc coating designation g90 Z275. Exposed surfaces of metal products shall be factory finished with satin white enamel.

2.1.2. **Hangers:** Min 0.1084" (12 gsg) overall thickness galvanized steel wire to zinc coating designation g90 Z275.

2.1.3. **Main Tees:** 12' long, 15/16" face width double web design, rectangular bulb at top of web, 1-1/2" web height. (Expansion cut-outs in main tees controlling buckling caused by heat expansion.)

2.1.4. **Main Tee Splices:** Designed to lock lengths of main tees together so that joined lengths of tee function structurally as single unit with tee faces at joint perfectly aligned and presenting tight seam.

2.1.5. **Cross Tees:** 1220 mm (4') long, 25 mm (1") web height structural cross-section, design same as main tees, designed to connect at main tees forming positive lock without play, loss or gain in grid dimensions with offset over-ride of face flange over main tee flange to provide flush joint. Provide 38 mm (1-1/2") web height of cross-tee for fire rated assemblies.

2.1.6. **Edge Moulding:** Materials and finish to match tees.

2.1.7. **Hold-Down Clips:** As recommended by lay-in panel manufacturer.

2.1.8. **Fasteners:** Galvanized and of size suited to loading conditions.

2.1.9. Labeling by Underwriters' Laboratories of Canada.

2.1.10. **Suspended Exposed Tee System:** two directional exposed grid,

Acceptable Products

CGC Donn

Bailey

Armstrong World Industries Canada

Series Donn DX

Standard B.E. Safe-T-Lock

Prelude MX and ML

- 2.2. **Lay-in Panels:** to ASTM E1264, acoustical units, for type, form, pattern, prefabricated, and meeting following performance criteria:
- | | |
|------------------------------|--------------------|
| Noise Reduction Co-efficient | not less than 0.75 |
| Light Reflectance | not less than 0.90 |
| CAC | not less than 35. |

- .1 Acoustic Ceiling Tile 1: to ASTM E1264, as follows.
- .1 Type: **ACT-1**.
 - .2 Cellulose fibre with high recycled content, minimum 65% total pre- and post-consumer content.
 - .3 Pattern Designation: non-directional visual, fine texture.
 - .4 Fire Classification: Class A:
 - .1 Flame spread rating of 25 or less, in accordance with CAN/ULC-S102.
 - .2 Smoke developed 50 or less in accordance with CAN/ULC-S102.
 - .5 Light Reflectance (LR) range of 0.82 to 0.86 to ASTM E 1477.
 - .6 Edge type: square, lay-in.
 - .7 Colour: white.
 - .8 Size: 610 x 610 x 19mm thick.
 - .9 Standard of acceptance: CGC Eclipse High-NRC, #76575HRC.
 - .10 Acceptable alternates, only if compliant with all specified requirements:
 - .1 Armstrong Cirrus High NRC, #574HRC.
 - .2 CertainTeed Cashmere High NRC, #CM-457NRCP.
- .2 Acoustic Ceiling Tile 2: to ASTM E1264 and as follows.
- .1 Type: **ACT-2**.
 - .2 Cellulose fibre with minimum 50% recycled content.
 - .3 Pattern Designation: non-directional visual, fine texture, 150 x 1220mm linear plank/strip pattern.
 - .4 Fire Classification: Class A:
 - .1 Flame spread rating of 25 or less, in accordance with CAN/ULC-S102.
 - .2 Smoke developed 50 or less in accordance with CAN/ULC-S102.
 - .5 Light Reflectance (LR) range of 0.82 to 0.86 to ASTM E 1477.
 - .6 Edge type: bevelled, tegular.
 - .7 Colour: white.
 - .8 Size: 150 x 1220 x 19mm thick.
 - .9 Standard of acceptance: Armstrong Optima.
 - .10 Acceptable alternate, only if compliant with all specified requirements:
 - .1 CGC.
 - .2 CertainTeed.

3. **EXECUTION**

3.1. **INSTALLATION**

- 3.1.1. Install suspended ceiling system in accordance with ASTM C636 and to manufacturer's instructions.
- 3.1.2. Install supporting inserts for hangers of suspended ceiling system into concrete slab above.
- 3.1.3. Install acoustic ceilings using tradesmen skilled in this class of work, in strict accordance with manufacturer's instructions and as specified herein.
- 3.1.4. Neatly and symmetrically install suspended ceiling to true lines, evenly balanced to pattern indicated on Drawings or as directed.
- 3.1.5. Centre ceiling system on room axis unless otherwise thereon or directed leaving equal border panels not less than ½ a full width.
- 3.1.6. Recessed items shall replace or be centered on acoustical panels, except where shown otherwise. Consult with Mechanical and Electrical Divisions to co-ordinate work. Provide additional supports where required.
- 3.1.7. Space hangers for suspended ceilings to support grillage independent on walls, columns, pipes and ducts at maximum 1220 mm (4') centres along support grillage and not more than 150 mm (6") from ends. Provide additional hangers at light fixtures and diffusers.
- 3.1.8. **Suspension to Metal Deck:** Punch lower part of metal deck with special puncher at required distances. Put hanger wire through holes, turn down, make a loop and securely wrap 3 times.
- 3.1.9. Provide written confirmations to Divisions 23, Mechanical and 26, Electrical, when requested by Consultant, that suspended ceiling is capable of supporting additional weight of mechanical and electrical fixtures specified in Division 23, Mechanical and Division 26, Electrical.
- 3.1.10. Run main tees at right angles to length of light fixtures.
- 3.1.11. Space main tees 1220 mm (4') o.c. in 1 direction and securely tie to hangers.
- 3.1.12. Space cross tees 610 mm (2') o.c. at right angles to main tees and properly lock a intersections.
- 3.1.13. Level suspended systems with a maximum tolerance of 3 mm (1/8") over 3.6 m (12').
- 3.1.14. Use longest practical lengths of tees, furring and running channels to minimize joints. Make joints square, tight, flush and reinforced with concealed splines. Assemble framework to form a rigid and interlocking system.

- 3.1.15. Design suspension system to accommodate movement caused by thermal expansion or contraction.
- 3.1.16. Design and space hangers and carrying members to support entire ceiling system, including lighting fixtures, diffusers and equipment openings in locations indicated on Drawings.
- 3.1.17. Use edge moulding where ceiling abuts vertical surface.
- 3.1.18. Use corner moulding along external edges at ceiling steps.
- 3.1.19. Provide expansion joints coincident with expansion joints in structure by interrupting crossing members and running two independent cross or main tees spaced 25 mm (1") apart and install joint filler.

3.2. INSTALLATION - EXPOSED TEE GRID SYSTEM

- 3.2.1. Join abutting sections of main tees by means of suitable connections such as splices, interlocking ends, tab locks, pin locks.
- 3.2.2. Intersecting tees shall form a right angle and be flush on exposed surface.
- 3.2.3. Butt ends of cross tees flush to exposed edge of intersecting member.
- 3.2.4. Provide edge moulding at intersection of ceiling and vertical surfaces.
- 3.2.5. Provide hold-down clips on all lay-in panels in areas where differential air pressure occurs and within 6 m (20') of an exterior door.
- 3.2.6. Coordinate work of this Section with installation of attachment clip system by Section 09 29 00 Gypsum Board.

3.3. Cleaning

- 3.3.1. Clean system of all paint and scuff marks and touch up scratches, abrasions and other defects.

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 REFERENCES

ASTM F1913-04 (2014)	Standard Specification for Vinyl Sheet Floor Covering without Backing.
ASTM F1303-04 (2014)	Standard Specification for Vinyl Sheet Floor Covering with Backing.
ASTM D2047-17	Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
ASTM F1515	Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change.
ASTM D2047-17	Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
ASTM F970-17	Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading.
ASTM E648-17a	Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
ASTM F150-06(2013)	Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring.

1.3 SUBMITTALS/SAMPLES

1.3.1 Submit samples in accordance with Section 01 33 00 Submittals.

1.3.2 Submit duplicate 300 mm x 300 mm (12" x 12") samples of flooring and base material for Consultant's approval, before ordering.

1.3.3 Rubber Athletic Tile Flooring contains 53% pre-consumer recycled content.

1.4 MAINTENANCE DATA & INSTRUCTIONS

1.4.1 Provide 3 copies of detailed instructions for maintaining, preserving and keeping resilient flooring clean.

1.4.2 Include adequate warning of maintenance practices or materials detrimental to resilient flooring.

1.5 QUALITY ASSURANCE

1.5.1 **Surface Burning Characteristics:** to CAN/ULC-S102.2-M.

1.5.2 Work shall be executed by company approved by manufacturer and experienced in this type of installation, having successful history of similar installations.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Deliver products in accordance with manufacturers' written recommendations. Label containers to clearly identify contents by product description, manufacturer, lot number, size, colour and pattern.

1.6.2 Protect materials from freezing.

1.6.3 Deliver products to area of work minimum 24 hours prior to installation. Remove them from containers to allow them to become fully acclimatized.

1.7 ENVIRONMENTAL REQUIREMENTS

1.7.1 Ensure temperature of room floor surface and materials is not less than 21 deg C (70 deg F) for 24 hours before, during and for 7 days minimum after installation.

1.7.2 Room temperature shall be 75 ± 10° F (23.9 ± 5.5° C) at least 48 hours prior to, during and after installation.

1.7.3 Ensure humidity levels of spaces to receive tile are maintained at design levels for minimum 24 hours before installation.

1.7.4 Avoid high humidity, cold drafts and abrupt temperature change.

1.8 WARRANTY

- 1.8.1 Warrant work of this Section against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become evident during warranty period including, but not be limited to, buckling, opening of seams, bond failure and extensive colour fading, to satisfaction of Owner at no expense to Owner.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 **Vinyl Sheet Flooring:** to ASTM F1913 Performance Standards for Homogeneous Single Layered Vinyl Sheet Floor Covering without Backing. Melodia 3.0 Flooring, Roll - 2 m wide (6'-6") 23 linear meters (75'-9"); thickness, 2 mm (0.080" gauge) – The Tarkett Collection sheet, as manufactured by Johnsonite, Colour: Main colour 21020717 Melodia Flint Grey; Accent Colour 'A', 21020708 Melodia Volcanic Ash; Accent Colour 'B', 21020701 Melodia Dove Grey. ** Colour selection may be subject to change to the approval of the Owner/Consultant.

Weld rods to match colour of flooring.

- 2.1.2 **Preformed Flash Cove Base:** Install cove fillet strip and vinyl cove same colour as vinyl sheet flooring, 100 mm high. Attach cap to wall at designated height. Notch and form outside corners in the cap. Fillet strip should have a 1-1/8" radius. Cove stick should be precisely mitered at all inside and outside corners and firmly secured into the floor or the wall.

Install preformed flashcoving skirting at floor by heat welding process at seams using special heat welding rod. Provide internal and external corners as coved skirting by mitre cutting. Conform to manufacturer's written recommendations to provide neat well fitted coved skirting.

- 2.1.3 **Anti-static Sheet Flooring:** to ASTM F1303, Type II, Grade 1, Class B performance sheet vinyl floorcovering with backing. iQ Granit SD as manufactured by Johnsonite or equal. GRTSD-R, rolls with wearlayer thickness 2.0 mm (0.80"), Sheet 2 m wide x 25 m linear length (6'-6" x 82'-7") per roll. Colour: Vintage 445 0445

- .1 Static coefficient of friction (ASTM D2047): >0.5
- .2 Resistance to Light (ASTM F1414): $\Delta \leq 8$
- .3 Static Load Limit (ASTM F970): Meets 250 psi with less than 5 mil (0.005") residual indentation.
- .4 Fire Performance (ASTM E648): Critical Radiant Flux – Class 1
- .5 Electrical Resistance (ASTM F150-100V: Resistance to Ground 2×10^8 ohms.
- .6 Meets ANSI/ESD S7.1 ($<10^9$ ohms): Results $<2.5 \times 10^8$
- .7 Meets OSHA/NFPA of minimum resistance 2.5×10^4 ohms): Results $< 2 \times 10^8$ ohms.

-
- 2.1.4 **Anti-static Sheet Flooring Adhesive: Shall be low VOC adhesive**
 .1 Roll Adhesive, Tarkett 925 Adhesive
 .2 Conductive Adhesive Tarkett 906
 .3 Copper Ground for Tile & Sheet: Product Number 1256727
- 2.1.5 **Thresholds, Adapters to vinyl sheet flooring to adjacent flooring:** rubber transition as manufactured by Johnsonite to suit depth of floor at adjoining carpet tile or other sheet flooring. Colour to be selected by Consultant. Where flooring meets ceramic tile or epoxy flooring transition is noted under those specification sections.
- 2.2 **Primers and Adhesives:** Tarkett RollSmart, Tarkett SpraySmart 901, Tarkett 959, Tarkett LVT Rollable or Tarkett 959HM – adhesives & primers, adhesive trowel size as recommended by manufacturer. Apply adhesive as recommended by applicable flooring and base manufacturers which will produce good and permanent bond between substrate and flooring, and between wall surface and base. Flooring installer must use manufacturer's product for manufacturer's warranty to apply.
- 2.3 **Levelling Materials:** as recommended by flooring manufacturer, compatible to their product and adhesives.
- 2.4 **Neutral Cleaner:** Taski 'Profi' or Johnson Wax Professional 'Stride' oil and grease emulsifying neutral detergents (pH of 7-8).
- 2.5 Flooring Base at Anti-Static Flooring: 4" high, rubber base, Charcoal 20, by Johnsonite or equal.
- 2.6 Wall Base Adhesive: as recommended by Manufacturer.
- 3 **EXECUTION**
- 3.1 **INSPECTION**
- 3.1.1 Ensure that substrate is dry and smooth. Report to Consultant any irregularities detrimental to flooring application.
- 3.2 **PREPARATION**
- 3.2.1 Clean and vacuum floor free of dirt, grease or other deleterious matter that will affect adhesion of flooring. All floors must be clean, smooth flat to within 1/8" x 10 ft. and dry. Dust, scale, and loose particles must be removed. The surface must be free of solvents, paint, grease, oil, was alkali, sealing/curing compounds, and any other foreign material, which could affect adhesive bonding.
- 3.2.2 Remove irregularities and fill depressions with non-shrinking latex compound.

3.2.3 **Remove all previously applied concrete sealers, curing agents, surface hardeners and other additives that may cause adhesive bonding failure. These should be removed by sanding or grinding or as directed by manufacturer.** Flooring preparation to be performed by flooring contractor.

3.2.4 Do not install flooring over expansion joints.

3.2.5 All concrete subfloors should be tested for moisture, pH (alkalinity) and proper bonding. Follow ASTM F-1869 recommendations for calcium chloride test. Alternate test F-2170 with a relative humidity level of 75% maximum.

3.2.6 The final responsibility for determining if the concrete is dry enough for installation of the flooring lies with the floor covering installer.

3.3 **INSTALLATION**

3.3.1 **Levelling Coat**

3.3.1.1 Fill joints in underlay with non-shrinking, latex cement filler. Force filler carefully into joints. Sand smooth when set.

3.3.1.2 Clean underlay of any substance deleterious to bond before applying tile.

3.3.1.3 Apply levelling coat over existing floors receiving new flooring where required. Prepare and prime existing surfaces, mix levelling compound, apply and finish levelling compound in strict accordance with manufacturer's printed instructions.

3.3.2 **Adhesive and flooring**

3.3.3 Install rolls in sequential order.

3.3.3.1 Apply adhesive uniformly with approved notch-tooth spreader at manufacturer's recommended rate.

3.3.3.2 Reverse alternate sheets.

3.3.3.3 Lay flooring with joints flush, uniform, in moderate contact. Fit by freehand knifing, direct scribing. Do not double cut flooring material.

3.3.3.4 Seam method: underscribe/recess scribe sheet.

3.3.3.5 Apply adhesive over the exposed subfloor including seam area. The adhesive should be spread in a straight line and approximately 12 inches away from where flooring is tubed back on itself. After adhesive has been given sufficient time to tack, apply a fresh band of adhesive to the 12 inch area at the folds in the sheet. This will allow for easier pull back of the second half of the material and will help prevent adhesive ridges from telegraphing. Position flooring slowly into adhesive when placing flooring into adhesive. Roll flooring in both directions with a 100 lb sectional floor roller. When rolling, stay approximately 6 inches away from seam area.

3.3.3.6 Heat weld seams 24 hours after installation. Use coordinated PVC rod. Rout approximately $\frac{3}{4}$ of the depth of the wear layer.

3.3.3.7 Treat end or head seams same as side seams. Do not use last six inches of material. End seams may require the area to be weighted down.

3.3.3.8 Install approved edging where floor tile terminates adjacent to dissimilar flooring material or at different finished floor height. Install thresholds at door ways.

3.3.4 Bases

3.3.4.1 Fill cracks and level irregularities of surface to which base is applied with filler approved by adhesive manufacturer to provide solid backing over entire area behind base.

3.3.4.2 Cement cove base to vertical surfaces so that gaps do not occur behind base, so that front lip of base cove bears firmly and uniformly on floor surfaces and so that good and permanent bond is produced between base and surface to which it is applied.

3.3.4.3 Apply bases as shown complete with stops. Use premoulded external and internal corners; mitre internal corners.

3.3.4.4 Use full length pieces where practicable, accumulated short lengths not permitted.

3.3.4.5 Butt joints and keep flush without gaps.

3.3.4.6 Install rubber base as per manufacturer's recommendations.

3.4 INITIAL CLEANING

3.4.1 Remove surplus adhesive from face of flooring and base as work progresses.

3.4.2 As soon as possible after adhesive has set, clean flooring and base surfaces using neutral cleaner in accordance with manufacturer's directions.

3.4.3 Do not let cleaning solution dry

3.4.4 Scrub the flooring: use a 22 ga nylon bristle brush or low abrasive pad (tan or red) on a single disk rotary/scrubbing machine at low speed (150-200 RPM)

3.4.5 Allow the flooring to dry thoroughly (approximately one hour) and then remove all water by vacuum or mop. Replace rinse water often.

3.4.6 Protect floor from damage.

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

1.2.1 Section 03 30 00 Cast-In Place Concrete

1.2.2 Section 09 31 00 Tile - for Reducer Strip

1.3 REFERENCES

1.3.1 American Society for Testing and Materials (ASTM):

- .1 ASTM F 1861 Standard Specification for Resilient Wall Base.
- .2 ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- .3 ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- .4 ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- .5 ASTM F 1482 Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring.
- .6 ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- .7 ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- .8 ASTM E 492 Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine.
- .9 ASTM E 492 Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine
- .10 ASTM E 989 Standard Classification for Determination of Impact Insulation Class (IIC)

1.3.2 National Fire Protection Association (NFPA):

- .1 NFPA 253 Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- .2 NFPA 258 Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

- .1 Standards Council of Canada: CAN/ULC S102 Standard
Method of Test for Surface Burning Characteristics of
Building Materials and Assemblies

1.4 **SYSTEM DESCRIPTION**

- 1.4.1 Performance Requirements: Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.

1.5 **SUBMITTALS**

- 1.5.1 Submit samples in accordance with Section 01 33 00 Submittals.
- 1.5.2 Product Data: Submit product data, including manufacturer's product sheet, for specified products.
- 1.5.3 Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, finish colors, patterns and textures.
- 1.5.4 Submit duplicate full size samples of flooring and base material for Consultant's approval, before ordering.
- 1.5.5 Quality Assurance Submittals: Submit the following:
 - .1 Manufacturers Technical Data: Manufacturers document specifying performance characteristics and criteria, and physical requirements
 - .2 Manufacturer's Instructions: Manufacturer's installation instructions.
- 1.5.6 Submit manufacturer's **environmental product declaration** for inclusion in the Close-out Submittals, including compliance to LEED credit for VOC content.
 - Credit EQ 4.1: For adhesives, include printed statement of VOC content and chemical components

1.6 **MAINTENANCE DATA & INSTRUCTIONS**

- 1.6.1 Provide 3 copies of detailed instructions for maintaining, preserving and keeping resilient textile flooring clean in accordance with Section 01 13 00 Administrative Requirements.
- 1.6.2 Include adequate warning of maintenance practices or materials detrimental to resilient flooring.

1.7 **QUALITY ASSURANCE**

- 1.7.1 Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

- 1.7.2 Work shall be executed by company approved by manufacturer and experienced in this type of installation, having successful history of similar installations.

- .1 Must be a Forbo Certified Installer.
- .2 Proof of valid certification must be submitted to the GC and verified by Forbo Flooring Systems prior to the start of the project.
- .3 The Forbo Certified Installer must manage and be on site during installation at all times.
- .4 Certificate: Submit certificate indicating installer qualifications for project. This project requires a Forbo Associate Mechanic for standard installations.

1.8 DELIVERY, STORAGE AND HANDLING

- 1.8.1 Deliver products in accordance with manufacturers' written recommendations. Label containers to clearly identify contents by product description, manufacturer, lot number, size, colour and pattern.

- 1.8.2 Protect materials from freezing.

- 1.8.3 Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

- 1. Material should be stored in areas that are fully enclosed and weathertight. The permanent HVAC should be fully operational, controlled and set at a minimum of 68. F (20. C) for at least 48 hours prior to the installation.

1.9 ENVIRONMENTAL REQUIREMENTS

- 1.9.1 Environmental Requirements/Conditions: In accordance with manufacturer's recommendations, areas to receive flooring should be clean, fully enclosed and weathertight. The permanent HVAC must be fully operational, controlled and set at a minimum of 68o F (20o C) for a minimum of seven days prior to, during, and seven days after the installation. The flooring material should be conditioned in the same manner for at least 48 hours prior to the installation. Areas to receive flooring shall be adequately lighted to allow for proper inspection of the substrate, installation and seaming of the flooring, and for final inspection.

- 1.9.2 Room temperature shall be 75 ± 10° F (23.9 ± 5.5° C) at least 48 hours prior to, during and after installation. Temperature Requirements: Maintain air temperature in spaces where products will be installed for time period before, during, and after installation as recommended by manufacturer.

- .1 Temperature Conditions: 68o F (20o C) for a minimum of seven days prior to, during, and seven days after the installation.

- 1.9.3 Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.10 **WARRANTY**

- 1.10.1 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 a limitation of, other rights Owner may have under Contract Documents.

2 **PRODUCTS**

2.1 **MATERIALS**

2.1.1 **Proprietary Product:** Flotex Metro Resilient Tile and Adhesive

- .1 Description: Flocked textile sheet floor covering has 100% nylon type wear layer with an intermediate fiberglass layer and a recycled vinyl cushioned base. Location: Interview 106 & 124.
- .2 Size: Approx. 20" x 20" (50cm x 50cm)
- .3 Carton Size: 12 tiles (32.3 feet², 3 meters²)
- .4 Gauge: 0.21" (5.3mm)
- .5 Backing: Recycled Vinyl Cushioned Backing
- .6 Pattern and Color: t546011 Metro Pebble
- .7 Adhesive: Forbo FRT 950 Adhesive
- .8 Sanitized(R) Treatment
- .9 Manufacturer: Forbo

- 2.1.2 **Rubber Base:** Resilient base where indicated on drawings: top set, coved, rubber, minimum 4" (100 mm) high x 1/8" (3 mm) thick, including premoulded end stops and external corners, as manufactured by Johnsonite. Colour: 20 Charcoal – Johnsonite.

- 2.1.3 **Thresholds, Adapters to epoxy flooring:** Schiene by Schluter or equal, L-shaped profile with 3.2 mm (1/8") wide top section and vertical wall section, that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.

- .1 Anchoring leg: Provide with straight anchoring leg.
- .2 Material and Finish: AE – Satin Anodized Aluminum
- .3 Height as required.

- 2.2 **Primers and Adhesives for Wall Base:** 960 Cove Base Adhesive adhesive trowel size 1/32" x 1/16" x 1/32". Apply adhesive as recommended by applicable flooring and base manufacturer's recommendations which will produce good and permanent bond between substrate and flooring, and between wall surface and base. Flooring installer must use manufacturer's product for manufacturer's warranty to apply.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (bond testing, pH testing, calcium chloride testing, relative humidity testing, etc.)

3.1.2 Material Inspection: In accordance with manufacturer's installation requirements, visually inspect materials prior to installation. Material with visual defects shall not be installed and shall not be considered as a legitimate claim.

3.2 PREPARATION

3.2.1 Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

3.2.2 Surface Preparation:

1. General: Prepare floor substrate in accordance with manufacturer's instructions.
2. Floor Substrate: Floors shall be sound, smooth, flat, permanently dry, clean, and free of all foreign materials including, but not limited to, dust, paint, grease, oils, solvents, curing and hardening compounds, sealers, asphalt and old adhesive residue.
3. Concrete Floor Substrate: Concrete floor substrate shall have a minimum compressive strength of 3,000 psi. Refer to Division 3 Concrete sections for patching and repairing crack materials and leveling compounds with Portland cement based compounds.
 - a. Reference Standard: Comply with the latest version of ASTM F 710 Standard Practice for

3.2.3 Concrete Moisture Testing: Conduct moisture tests on all concrete floors regardless of the age, grade level or the presence of existing flooring. Conduct calcium chloride tests in accordance with the latest version of ASTM F 1869. Measure the internal relative humidity of the concrete slab in accordance with the latest version of ASTM F 2170. One test of each type should be conducted for every 1,000 square feet of flooring (minimum of 3). The tests should be conducted around the perimeter of the room, at columns, and anywhere moisture may be evident. Concrete moisture vapor emissions must not exceed 5.0 lbs. per 1,000 square feet in 24 hours when using Forbo FRT 950 adhesive. Concrete internal relative humidity must not exceed 75% when using Forbo FRT 950 adhesive. A diagram of the area showing the location and results of each test should be submitted to the Architect, General Contractor or End User. If the test results exceed these limitations, the installation must not proceed until the problem has been corrected.

3.2.4 Concrete pH Test: Perform pH tests on concrete floors regardless of the age or grade level. The surface pH of concrete slabs must not exceed a pH of 10. Concrete substrates with pH readings less than 7.0 or above 10.0 will require remediation prior to installation.

3.2.5 **Remove all previously applied concrete sealers, curing agents, surface hardeners and other additives that may cause adhesive bonding failure. These should be removed by sanding or grinding or as directed by manufacturer.** Flooring preparation to be performed by flooring contractor.

3.2.6 Do not install flooring over expansion joints.

3.3 **INSTALLATION**

3.3.1 Material Installation: Establish a line along the center of the longest dimension of the area to be installed. Determine the center of the starting line and adjust the starting point as necessary to create the largest possible perimeter tile. Once the starting point has been determined, establish a second line that is perpendicular to the first line and intersects at the starting point. After establishing the starting lines, apply adhesive with nap roller. Allow the adhesive to turn clear and dry to the touch before installing. After turning clear, the flooring *MUST* be placed into the adhesive within four hours. Beginning at the starting point and carefully following the starting lines, install in a pyramid fashion in one quadrant of the area at a time. Install with the arrows at right angles to one another (quarter turned). *Note: Certain patterns may be installed with arrows all in the same direction.* Roll the completed installation with a 75 pound three-section roller in both directions and repeat as necessary to ensure adequate transfer of adhesive to the backing.

3.3.2 Adhesive Installation: Use nap roller as recommended by flooring manufacturer for specific adhesive (3/8" nap roller). Spread rate is approximately 300ft²/gallon.

3.3.3 Installation Techniques:

1. Where demountable partitions and other items are indicated for installation on top of finished flooring, install flooring before these items are installed.
2. Scribe, cut, fit flooring to butt tightly to vertical surfaces, permanent fixtures and built-in furniture, including pipes, outlets, edgings, thresholds, nosings, and cabinets.
3. Extend flooring into toe spaces, door reveals, closets, and similar openings.
4. Install flooring on covers for telephone and electrical ducts, and similar items occurring within finish floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers.
5. Do not install resilient flooring over expansion joints. Use expansion joint covers manufactured for use with resilient flooring. Refer to other specification sections for expansion joint covers.
6. Adhere resilient flooring to substrate without producing open cracks, voids, raising and puckering at joints or other surface imperfections in completed installation.
 - a. Use adhesive applied to substrate in compliance with manufacturer's recommendations, including those for mixing, trowel notch, and adhesive open and working times.
7. Roll resilient flooring as required by resilient flooring manufacturer.

3.3.4 Bases

- 3.3.4.1 Ensure that substrate is solid and free of voids, gaps, or other defects which will preclude adequate adhesion, or will ghost or telegraph through finished base installation.
- 3.3.4.2 Set base in adhesive tightly against wall and floor surfaces. Use pieces of base minimum 18" (0.5 m) long.
- 3.3.4.3 Lay out base to keep number of joints at minimum. Uniformly space joints; butt to moderate contact.
- 3.3.4.4 Scribe and fit to door frames and other obstructions. Use pre-moulded end pieces at flush door frames.
- 3.3.4.5 Cope internal corners. Use pre-moulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.

3.3.5 Transition Strip at Epoxy Flooring

- 3.3.5.1 Install as transition strip in coordination with Epoxy flooring section and install as per manufacturer's recommendations.

3.4 CLEANING

- 3.4.1 Remove surplus adhesive from face of flooring and base as work progresses. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.
 - .1 Remove visible adhesive and other surface blemishes using cleaning methods recommended by floor manufacturer.
 - .2 Vacuum floor after installation per manufacturer's recommendations.
 - .3 Spot clean using the "Scrape, Scrub, and Rinse" procedures per the manufacture's recommendations.

3.5 PROTECTION

- 3.5.1 Protect installed product and finish surfaces from damage during construction. Remove and legally dispose of protective covering at time of Substantial Completion.

End of Section

1 GENERAL

1.1 General Requirements

1.1.1 Conform to Sections of Division 1 as applicable.

1.1.2	Flooring Contractor must patch and level floor if required to do so. Final Cleaning – the entire sport floor shall require final cleaning.

1.2 Qualifications

1.2.1 Contractor shall be an established firm regularly engaged in the installation of specified flooring. Contractor shall have completed at least five projects of similar size and complexity.

1.3 Submittals

1.3.1 Provide duplicate samples for approval by Consultant as per Section 01 33 00 Submittals.

1.3.2 Rubber Athletic Tile Flooring contains 53% pre-consumer recycled content.

1.4 Handling And Storage

1.4.1 Install resilient products after other finishing operations, including painting, have been completed

1.4.2 Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by Johnsonite, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

2. 48 hours before installation.
3. During installation.
4. 48 hours after installation.

1.4.3 Maintain the ambient relative humidity between 40% and 60% during installation

1.4.4 Until Substantial Completion, maintain ambient temperatures within range recommended by Johnsonite, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

2 PRODUCTS

2.1 Materials:

- 2.1.1 Resilient Rubber: Triumph/Inertia – Standard Mesto: KN1 Rainy Day WG as manufactured by Johnsonite.
- a. Complies with requirements for ASTM F 1344 Standard Specification for Rubber Floor Tile Class 1-A and 1-B.
 - b. Tile manufactured of dual durometer layers composed of 100% synthetic and natural rubber.
 - c. Tile is two-ply vulcanized construction which incorporates a rubber wear layer and an elastic cushioned performance layer.
 - d. Tile is manufactured in compression mold; made flat, lays flat: no weighted blocks required during installation
 - e. Spike and Skate resistant.
 - f. Wear layer thickness: .090" (2.3 mm).
 - g. Overall thickness: 3/8" [.375" (9.5 mm)].
 - h. Tile design, texture, and color:
 - 1) Square Edge (glue down) Hammered Texture:
 - i. Tile size:
 - 1) Square Edge (glue down) 24" X 24" (61 cm x 61 cm)
 - j. ASTM D 2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring of 0.6 or greater.
 - k. ASTM F 970, Standard Test Method for Static Load Limit – passes 250 PSI.
 - l. ASTM D 3389 Standard Test Method for Coated Fabrics Abrasion Resistance: < 1.00 gram weight loss.
 - m. ASTM E 648, Standard Test method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I.
 - n. Johnsonite offers a RESTART reclamation program for returning jobsite scrap
 - o. Resilient Rubber athletic Flooring contains 7% rapidly renewable content
 - p. 100% Recyclable
 - q. Phthalate, chlorine and halogen-free
 - r. LEED contributions for Rubber Athletic Flooring includes MR2; MR4; MR5; and MR6
 - s. Rubber Athletic Tile Flooring contains 53% pre-consumer recycled content
 - t. FloorScore Certified for Indoor Air Quality
 - u. Cradle 2 Cradle Bronze Certified
 - v. Johnsonite facilities are ISO 9001 and ISO 14001 Certified

- 2.1.2 Sport Flooring Base: 4" high, rubber base, Charcoal 20, by Johnsonite or equal.
- 2.1.3 Floor filler: portland cement-based patching and leveling compounds, as recommended and manufactured by Ardex or Mapei and as supported by flooring manufacturer.
- 2.1.4 Reducer strips: Provide CTA-XX-L reducer strip, for transition at centreline of door where sport floor terminates at resilient sheet flooring
- a. 2.1.5 Primers and adhesives: recommended and manufactured for use by flooring manufacturer for specific material on applicable substrate. Credit EQ 4.1: For adhesives, include printed statement of VOC content and chemical components
- Adhesives: As recommended by Johnsonite to meet site conditions.
Resilient Rubber Athletic Flooring (For glue down tile only).
- a. Johnsonite 965 Flooring and Tread Adhesive
b. Johnsonite 975 Two-Part Urethane Adhesive
c. Johnsonite 140 SpraySmart Adhesive
- Wall Base adhesive: as recommended by manufacturer
- 2.1.6 Cleaners: Diversey "Profi", an oil and grease emulsifying neutral detergent (pH of 7-8)

3 EXECUTION

3.1 Preparation

- 3.1.1 Check concrete subfloors for moisture content in accordance with ASTM F-1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. One test should be conducted for every 1000 sq. ft. of flooring and the results not exceed 3 lbs. per 1000 sq. ft. in 24 hours. If the test results exceed the limitations, the installation must not proceed until the problem has been corrected.

A pH test for alkalinity must be conducted. Results should range between 7 and 9. If the test results are not within the acceptable range of 7 to 9, the installation must not proceed until the problem has been corrected.

Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.

Moisture testing must be conducted to identify if the MVER of the concrete is within the approved limits of the patching compound manufacturers specifications. (Follow patching compound manufactures instructions for proper selection and use.)

3.1.3 Subfloor shall be clean, dry, structurally sound, smooth and flat within 1/8" in 10 feet as recommended by flooring manufacturer. The surface must be free of solvents, paint, grease, oil, wax, alkali, sealing/curing compounds, and any other foreign material, which could effect adhesive bonding. Excessive alkali must be removed by mechanical means. (i.e.: bead blasting, sanding, or grinding).

3.1.4 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

3.2 Installation – Resilient Athletic Flooring

3.2.1 Unless otherwise specified, install specified flooring and base in strict accordance with manufacturer's printed instructions.

3.2.2 Ensure that materials match approved samples. Materials with undue variations in colour, texture and finish will be rejected.

3.2.3 Install with Johnsonite adhesive specified for the site conditions and follow adhesive label for proper use.

3.2.4 Do not quarter turn tile.

3.2.5 Roll the flooring in both directions using a 100 pound three-section roller.

3.2.6 Cut tile and fit neatly around fixed objects.

3.2.7 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.

3.2.8 Install reducer strip at unprotected or exposed edges where flooring terminates.

3.4 Base Application

3.4.1 Apply rubber base of wall as recommended by manufacturer

3.5 Maintenance

3.5.1 It is important to follow a proper and regular maintenance program to preserve the flooring. To support our customers maintenance program, Johnsonite recommends the use of Diversey cleaning products. For specific maintenance advice, please contact Diversey at 1-800-558-2332. (USA and Canada calls).

3.5.2 Step #1 - Post Installation Initial Cleaning

Initial cleaning should not be performed until seventy-two (72) hours after installation.

.1 Thoroughly sweep or dry vacuum the flooring to remove all loose dirt and grit.

.2 Prepare a cleaning solution of 6 to 8 oz of Taski "Profi", an oil and grease emulsifying neutral detergent (pH of 7-8), per gallon of warm water. The dilution selected depends on light to heavy soil conditions.

.3 Scrub the rubber flooring with the cleaning solution as follows:

Small area installations: use a deck brush.

Large area installations: use a 22 -28 gauge flagged nylon bristle brush on a single disk scrubbing machine. (175- RPM).

.4 Wet vacuum the cleaning solution.

.5 Rinse with clean cold water, and then remove all water using a wet vacuum.

.6 Allow the flooring to dry thoroughly. (Approximately one hour, depending on temperature and humidity) Use oscillating fans to decrease drying times.

3.6 Protection of Finished Work

- 3.6.1 Protect new floors from time of final set of adhesive until final inspection. Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

1.2.1 Concrete Finishing: Section 03 30 45

1.2.2 Concrete Block work: Section 04 20 00 Masonry

1.2.3 Wall Coatings: Section 09 96 10, Interior Special Coating – Epoxy Paint

1.3 REFERENCES

ASTM C307-99	Test Method for tensile Strength of Chemicals Resistant Mortars, Grouts and Monolithic Surfacing
ASTM C413-01	Test Method for Absorption of Chemical-Resistant Mortars Grouts and Monolithic Surfacing and Polymer Concretes
ASTM C579-01	Test Method for Compressive Strength of Chemical-Resistant Mortars Grouts and Monolithic Surfacing
ASTM C580-02	Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes
ASTM D4263-83 (1999)	Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

1.4 SYSTEM PERFORMANCE REQUIREMENTS

1.4.1 Provide seamless epoxy flooring system that when cured, produces following physical properties when tested in accordance with Standards specified herein:

1.4.1.1 Compressive Strength: min 41 MPa (6,000 psi) when tested to ASTM C579.

1.4.1.2 Tensile Strength: min 10 MPa (1,500 psi) when tested to ASTM C307.

1.4.1.3 Flexural Strength: min 15 MPa (2,200 psi) when tested to ASTM C580.

1.4.1.4 Water Absorption: max 3% when tested to ASTM C413.

1.5 SUBMITTALS

1.5.1 **Product Data:** Submit manufacturer's technical data, installation instructions and general recommendations for each type of flooring material required.

1.5.2 **Samples:** Submit 300 mm x 300 mm (12" x 12") sample of flooring for approval. Submit additional samples until approval is obtained. Make changes in aggregate mix as required to secure correct colour and texture. Label sample(s) with Project name and number, applicator, names of material and manufacturer, area where material will be applied, date of sample, colour, gloss, texture and aggregate mix

proportion.

1.5.3 **Maintenance Data:** Submit maintenance manuals in accordance with Section 01 33 00, Submittals, containing specific instructions for maintenance, preservation and cleaning. Provide adequate warning of maintenance materials or practices which may be detrimental to flooring.

1.5.4 **Test Reports:** If requested, submit test data reports indicating that material/system supplied and installed meets performance requirements listed herein.

1.6 **QUALITY ASSURANCE**

1.6.1 **Qualifications**

1.6.1.1 Execute work of this Section by applicator approved by flooring manufacturer, having proven record of satisfactory installations similar to that specified within last 5 years, and with necessary equipment and skilled workers to perform it expeditiously. If requested, submit proof of these qualifications.

1.6.2 **Coordination**

1.6.2.1 Coordinate work of this Section with work of Section 09 96 10 – Interior Special Coating. Ensure compatibility of floor and wall finish products where they come into contact. Coordinate installation to provide neatly finished overlap where floor and wall coatings meet.

1.6.3 **Testing**

1.6.3.1 Prior to commencement of work, do test installation to ensure that floor material is not affected physically or chemically by type of chemical(s) used in area.

1.6.4 **Mock-Ups**

1.6.4.1 At Site, in area designated by Consultant, erect sample floor area (1 room – Room #159) by required thickness as per specification including primer and necessary number of coats to obtain specified finish, showing colour range, bond and quality of work. Do no work until mock up has been approved. Approved sample shall become standard of comparison for flooring work on Site.

1.7 **TOLERANCES**

1.7.1 Finish seamless flooring surfaces to produce plumb and level floor, or straight where sloped to drains, within tolerance of 3 mm in 3 m (1/8" in 10').

1.8 **DELIVERY, STORAGE AND HANDLING**

1.8.1 Deliver materials to Site in original, unopened containers with manufacturers labels and seals intact. Labels shall identify manufacturer's name, brand name of product, grade and type, application directions and shelf life and/or expiry date of product.

1.8.2 Handle and store materials in accordance with manufacturer's printed directions.

1.8.3 Store flammable materials in safe, approved containers to eliminate fire hazards and remove from Site at end of each work shift.

1.8.4 Do not use materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.9 **PROJECT CONDITIONS**

1.9.1 **Environmental Requirements**

1.9.1.1 Do not apply flooring over substrate materials that contain over 3% moisture. Obtain approval of flooring manufacturer of moisture content of subfloors before proceeding with application.

1.9.1.2 Maintain minimum air and surface temperatures at 16 deg C (60 deg F) for 24 hours before, during, and for 48 hours following application, or until cured.

1.9.1.3 Maintain well-lit and well-ventilated area.

1.9.1.4 Comply with flooring manufacturer's directions for maintenance of substrate temperatures, ventilation and other conditions required to execute and protect work.

1.9.2 **Protection**

1.9.2.1 Protect adjacent surfaces from damage resulting from work of this Section. If necessary, cover or mask adjacent surfaces to those receiving flooring including fixtures and equipment.

1.9.2.2 Materials soiled by coatings during application and storage, and from which soil cannot be completely removed, shall be replaced by this Section at no extra cost.

1.9.2.3 Erect barriers to prevent entry and presence of workers not performing work of this Section during application of flooring and for 48 hours following completion of application.

1.9.2.4 Post "No Smoking" signs while work is in progress and curing. Ensure that spark-proof electrical equipment is used in areas where inflammable materials are being applied. Prevent use of open flames or equipment that may cause sparks during this phase of work.

1.10 **PRE-CONSTRUCTION MEETING**

1.10.1 Prior to start of work, arrange for Site meeting of all parties associated with work of this Section. Meeting shall include Contractor, Consultant, seamless flooring sub-contractor, manufacturer's representative and other sub-contractors whose work may be affected.

1.10.2 Review specification for work included under this section and determine complete understanding of requirements and responsibilities relative to work including storage and handling of materials, materials to be used, installation of materials, sequence and quality control. Project staffing, restrictions on areas of flooring

installation and other matters affecting construction to permit compliance with intent of this Section.

1.11 **WARRANTY**

- 1.11.1 Warrant work of this Section against defects and deficiencies for a period of 2 years in accordance with General Conditions of the Contract. Promptly correct defects and deficiencies which become apparent within warranty period, including making good any work damaged by this work, satisfactory to Consultant and at no cost to Owner. Defects shall include, but not be limited to, discolouration, fading, pinholes, cracking, peeling, leaking. Damage due to structural failure of base, water seepage or abnormal abuse excepted.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 **General:** Materials used in application of each flooring system shall be of same manufacturer and same supplier.

- 2.1.2 **Epoxy Seamless Flooring: Stonblend HRI OR EQUAL** Must comply with troweled mortar base with broadcast topping. Liquid rich, slurry type systems will not be accepted, and will result in a disqualification from bid.

- 2.1.3 System Characteristics:

- 1 Color and Pattern: Choose from Mfg. Standards
- 2 Wearing Surface: Standard or medium.
- 3 Integral Cove Base: TBD inches.
- 4 Overall System Thickness: nominal 1/4"
- 5 Provide grit samples to verify type for each floor location to be approved by Client.

- 2.1.4 System Components: Manufacturer's standard components that are compatible with each other and as follows:

- 1 Primer:

- 1 Material Basis: Stonhard Standard Primer
- 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: Stonclad GS
- 2 Resin: Epoxy.
- 3 Formulation Description: (3) three component, 100 percent solids.
- 4 Application Method: Metal Trowel.
 - 1 Thickness of Coats: nominal 3/16" (inch).

- 2 Number of Coats: One.
- 5 Aggregates: Pigmented Blended aggregate.

3 Undercoat:

- 1 Material Basis: Stonshield undercoat.
- 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
- 2 Type: pigmented.
- 3 Finish: standard.
- 4 Number of Coats: one.
- 5 Pattern: Tweed.

5 Sealer:

- 1 Material Basis: Stonshield Sealer.
- 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.

2.1.5 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 C 579.
- 2 Tensile Strength: 2,000 psi per ASTM C 307.
- 3 Flexural Strength: 4,300 psi per ASTM C 580.
- 4 Water Absorption: < 1% per ASTM C 413.
- 5 Impact Resistance: > 160 in. lbs. per ASTM D 2794.
- 6 Flammability: Class 1 per ASTM E-648.
- 7 Hardness: 85 to 90, Shore D per ASTM D 2240.

2.1.6 **Divider Strips:** 'L' shape to required floor thickness, white alloy zinc.

2.1.7 **Cove Strips:** as recommended by flooring manufacturer.

2.1.8 **Joint Backing:** preformed, compressible strips of closed cell polyethylene or urethane foam, rubber tubing or non-migrating plasticized vinyl with shore 'A' hardness of 20 and tensile strength between 140 kPa and 200 kPa. Sizes and shapes to suit various conditions, diameter 25% greater than joint width. Compatible with sealant, primer, epoxy surfacing and substrate.

- 2.1.9 **Joint Sealant:** Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated; Stonflex MP7 joint fill material, and CT5 concrete crack treatment or equal.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Ensure that concrete slab has been properly cured and dry for minimum of 28 days.
- 3.1.2 Ensure that slab on grade has been adequately waterproofed beneath and at perimeter of slab and on earth side of below grade walls.
- 3.1.3 Ensure that no curing and sealing compounds, hardeners or other chemical additives have been used on concrete.
- 3.1.4 Verify that specified environmental conditions are maintained before commencing work. Be familiar with manufacturer's product literature and Material Safety Data Sheets and comply with precautions, handling procedures and equipment requirements.
- 3.1.5 Before proceeding with application, test surfaces for moisture content in accordance with ASTM D4263 to ensure that they are suitable for application. Report results to Consultant and obtain manufacturer's representative's approval before proceeding.
- 3.1.6 Do not start work until unsatisfactory conditions have been corrected. Commencement of work indicates acceptance of all surfaces and conditions.

3.2 PREPARATION

- 3.2.1 Clean subfloor free of laitance, oil, grease and other foreign matter detrimental to flooring application. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application
- 3.2.2 Prepare new concrete floors over entire area with steel shot blasting or other method recommended by manufacturer. Remove uneven joints, rough areas, foreign and projection off surfaces. Surface to be hard, sound, and roughened to irregular surface with weak concrete removed and surface holes and voids exposed. Equip dry blasting machine with vacuum to minimize dust.
- 3.2.3 Repair cracks, holes or other deficiencies in accordance with manufacturer's recommendations.
- 3.2.4 Blow clean control joints, sawcuts and cracks with compressed air and grout with material compatible with floor coating materials.
- 3.2.5 Verify that concrete substrates are dry.

- .1 Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 75 percent.
- .2 Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. of slab in 24 hours.
- .3 Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

3.2.6 Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

3.2.7 Ensure that masonry backing surfaces for cove bases are free of voids and irregularities. Fill recessed joints with recommended epoxy plaster.

3.2.8 Obtain Consultant's approval of prepared substrate before installation of flooring.

3.3 **INSTALLATION**

3.3.1 **General**

3.3.2 Prepare, mix materials and apply each component of flooring system in strict accordance with manufacturer's printed directions to produce uniform monolithic wearing surface of thickness indicated for each system, with integral cove bases, uninterrupted except at divider strips, sawn joints or other types of joints required.

3.3.3 Apply flooring with care to ensure that no laps, pin holes, voids, crawls, skips or other marks or irregularities are visible, and to provide uniform appearance.

3.3.4 Work coating into corners and other restricted areas, up and over equipment bases, and into recesses in floors to ensure full coverage.

3.3.5 Make clean true junctions with no visible overlap between adjoining applications of coatings.

3.3.6 Match approved sample for colour, sheen, texture and slip resistance.

3.3.7 For large areas, stop each day's production at metal dividing strip at lines approved by Consultant.

3.3.8 **Application**

3.3.8.1 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.

- a) Apply joint sealant to comply with manufacturer's written recommendations.

3.3.9 **Primer**

- 3.3.9.1 Apply primer over prepared substrate, at manufacturer's recommended spreading rate with timing of application coordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.

3.3.10 **Trowel Applied Epoxy Matrix**

- 3.3.10.1 Apply metal trowel single mortar coat in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.

- 3.3.10.2 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.

- 3.3.10.3 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.

3.3.11 **Grout Top Coats**

- 3.3.11.1 Apply minimum of 2 finish coats at spreading rate recommended by manufacturer to achieve 0.254 mm (10 mils) minimum thickness and consistent appearance. Immediately broadcast sand aggregates to freshly applied grout coat to obtain slip-resistant texture finish. Finish to match approved samples. Allow minimum recommended drying time between coats.

3.3.12 **Cove Bases**

- 3.3.12.1 Provide 100 mm (4") high cove base struck straight to provide line for wall finish. Cap with manufacturer's recommended cove strip.

- 3.3.12.2 Terminate base 150 mm (6") high, feather out and trim evenly along wall to provide smooth transition with adjacent wall finish. Ensure top coat is compatible with wall coating prior to application.

- 3.3.12.3 Round interior and exterior corners.

- 3.3.12.4 Provide integral seal at the joint between the floor and the wall finish.

3.3.13 Thresholds

- 3.3.13.1 Where flooring terminates at doorways, and difference in height occurs between seamless flooring and other finishes, install tapered aluminum thresholds not less than 25 mm (1") wide and full thickness of difference in level.
- 3.3.13.2 Where flooring terminates at doorways, and difference in height occurs between seamless flooring and other floor finishes, cut back slab for 32 mm (1-1/4") width to allow full thickness of seamless flooring to be flush with adjacent floor finish (chasing).
- 3.3.13.3 Where flooring terminates at doorways, and floor finishes are of same thickness, provide metal divider strips flush with surfaces.

3.3.14 Floor Drains

- 3.3.14.1 Slope flooring to drains minimum of 3.2 mm in 300 mm (1/8" in 12") from furthest surface point.
- 3.3.14.2 Grind concrete around perimeter to provide 6 mm (1/4") thickness of flooring material which is flush with top of drain and slopes as indicated on Drawings.
- 3.3.15 **Chasing:** Provide chase where flooring does not abut against vertical surface by chiselling out 38 mm (1-1/2") wide chase to straight saw-cut 12 mm (1/2") depth.
- 3.3.16 **Control Joints:** Where substrate is interrupted by isolation, control or expansion joints, provide saw-cut joint in flooring after floor installation, install backer rod and fill with manufacturer's recommended epoxy or urethane sealant.

3.4 FIELD QUALITY CONTROL

- 3.4.1 **Manufacturer's Field Services:** Ensure flooring manufacturer's representative's presence at pre-construction site meeting and on Site on day flooring application is commenced and periodically thereafter, to ensure work is properly performed.

3.5 ADJUSTMENT AND CLEANING

- 3.5.1 Touch up and refinish minor defects in work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.
- 3.5.2 Remove promptly as work progresses spilled or splattered coating materials from adjacent surfaces. Clean floors on completion of Work. Do not mar surfaces while removing splatters.
- 3.5.3 Protect completed work from traffic for at least 1 week to allow proper curing of floor finish. Protect work from any trades using area after completion of installation.

End of Section.

Part 1 General

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittals.
- .2 Section 01 35 00 – Environmental Protection Requirements.
- .3 Section 09 29 00 – Gypsum Board.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM C423, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .2 ASTM E84-18a, Standard Test Method for Surface Burning Characteristics of Building Material.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittals.
- .2 Submit duplicate samples, approx. 100 mm x 100 mm of each type acoustical unit.

1.5 CLOSE-OUT SUBMITTALS

- .1 Submit manufacturer's **environmental product declaration** for inclusion in the Close-out Submittals, VOC content.

1.6 ENVIRONMENTAL REQUIREMENTS

- .1 Commence installation after building enclosed and dust generating activities are completed.
- .2 Permit wet work to dry prior to commencement of installation.

- .3 Maintain uniform minimum temperature of 15°C and relative humidity of 20- 40% prior to, during and after installation.

1.7 WASTE MANAGEMENT

- .1 Separate and recycle waste materials in accordance with Section 01 35 00 – Environmental Protection Requirements.
- .2 Divert unused metal materials from landfill to metal recycling facility.
- .3 Dispose of unused paint and adhesive material at official hazardous material collections site.
- .4 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.
- .5 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .6 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material [in appropriate on-site for recycling.

Part 2 Products

2.1 MATERIALS

- .1 Acoustic wall panels: Zintra® Acoustic ½” Panels as manufactured by Crown Wallpaper or equal. At Public Interview 106, Soft Interview 212.
 - .1 Content: 100% Polyester.
 - .2 Acoustic Rating: 0.45-0.90 NRC.
 - .3 Fire Rating: in accordance with ASTM-E84, Class A fire rating.
 - .4 Surface Finish: Matte
 - .5 Colour: from manufacturer’s standard colours .
 - .6 Size: 1220mm x 2745 mm x 12 mm thick (4’ x 9’ x ½”)
 - .7 L-Angle: 13mm x 25 mm (½” x 1”) satin anodized as provided by manufacturer.
- .2 Cementitious wood fibre acoustic units: Tectum® Direct-Attached High NRC by Armstrong World Industries, Inc. or equal. At Interview 104.
 - .1 Standard units: 23-3/4” x 48” x 1” thick, long side bevelled and short side square edged, colour: white finish; Mounting, Type A
 - .2 NRC: ASTM C423; 0.40
 - .3 Flame spread Index: 25 or less; Smoke Developed Index 50 or less when tested in accordance with ASTM E84
 - .4 Fasteners, size and type as recommended by manufacturer. Fastener must be tamperproof and approved by Client.

Part 3 Execution

3.1 INSTALLATION

- .1 Ensure substrate surface is straight to tolerance of plus or minus 3 mm over 3000 mm.
- .2 Install acoustic units to clean, dry and firm substrate using adhesive.
- .3 Install acoustic units plumb and aligned. Arrange units symmetrical on each wall. Cut units to be at least 50 % of unit width.
- .4 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding – 'L' angle.

3.2 CLEANING

- .1 Keep acoustic installation and all components clean. Remove blemishes immediately.

3.3 PROTECTION

- .1 Protect finished acoustical wall treatment from damage.
- .2 Remove prior to substantial completion.

END OF SECTION

1. **GENERAL**

1.1. Conform to Sections of Division 1 as applicable.

1.2. **DEFINITIONS**

1.2.1. "Exposed" means visible in completed Work. In case of closets, cabinets and drawers, it includes their interiors.

1.3. **QUALITY ASSURANCE**

1.3.1. Perform work of this Section by applicator with minimum 5 years of proven, satisfactory and successful painting experience on projects of similar size and nature. Submit proof of such experience with list of projects in Canada upon Consultant's request. Provide qualified crew of painters and full time review of work by qualified supervisor for duration of work.

1.3.2. As work progresses and upon completion of work, submit written reports and manufacturers' confirmation that materials and application methods conform to manufacturers' requirements.

1.4. **COLOUR SCHEDULE AND SAMPLES**

1.4.1. Submit in accordance with Section 01 33 00 - Submittals.

1.4.2. Samples:

.1 Submit for review and acceptance for colour matching.

.2 Submit duplicate 200 x 305 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.

.3 Retain approved samples in good and clean condition on job site until completion. Materials used in work shall match approved samples

.4 Consult with Architect to consider samples which will be inspected under the conditions and in areas to which colours and finishes are to be applied. Modify colours as often as may be required for Consultant final approval. Upon final approval, proceed with the purchase of materials

1.5. Close-Out Submittals:

1.5.1. Submit manufacturer's **environmental product declaration** for inclusion in the Close-out Submittals

1.6. **DELIVERY, STORAGE AND HANDLING**

- 1.6.1. Deliver materials in original containers with labels intact and store in area indicated in accordance with manufacturer's MSDS. Keep stored materials with lids securely covered.
- 1.6.2. Ventilate, heat and maintain storage area at minimum temperature of 10 deg C (50 deg F) and protected from direct rays of sun.
- 1.6.3. Take necessary precautions against fire and spontaneous combustion. Provide warning signs where toxic materials and explosive solvents are used. Provide CO₂ fire extinguisher of minimum 9 kg (20 lb) capacity in storage area while materials are stored within.
- 1.6.4. Leave storage areas clean and free from evidence of occupancy on completion.

1.7. **PROJECT CONDITIONS**

- 1.7.1. **Environmental Requirements:** Paint and finish in clean, dust-free, properly ventilated and adequately lit areas (minimum 100 lx (9.3 ft candles). Maintain adequate ventilation at all times to control excessive humidity.
- 1.7.2. Maintain minimum interior temperature of 18 deg C (65 deg F) during application and drying of paint and maintain until building occupancy occurs.

2. PRODUCTS

2.1. **MATERIALS**

2.1.1. **Painting and Finishing Materials**

- 2.1.1.1. Paint and finishing materials for each procedure listed in Finish Schedule shall be products of single manufacturer.
- 2.1.1.2. Paint products shall meet or exceed requirements of ECP-07 Guidelines for water based paints. In addition, paint products shall meet or exceed applicable performance standards issued by CGSB or other such standards approved by accredited standards writing organizations.
- 2.1.1.3. Paint shall have excellent flowing and brushing properties. Paint shall cure free of sags, runs, wrinkles to yield desired finish specified.
- 2.1.1.4. Number of competitive sources of supply are currently offering environmentally friendly paint products that conform to Environmental Choice Program guidelines and carry EcoLogo on paint containers. Several paint products currently supplied by following companies have been approved by ECP/CSA to carry EcoLogo. Not all products available from listed companies conform to stated guidelines.

2.1.1.5. **WATER BASED PAINTS**

Benjamin Moore and Co., Ltd.
Betonell Limited
ICI Paints (Canada) Inc.(Glidden, Color Your World Inc.,)
General Paint
Para Paints Canada Inc.
PPG Canada Inc. (Coatings and Resins Division)
Sherwin-Williams
Sico Inc.

- 2.1.1.6. Other manufacturer's products bearing EcoLogo shall be deemed acceptable provided they meet other requirements specified herein.

3. EXECUTION

3.1. Verification of Surface Conditions

- 3.1.1. Do work only when surfaces and conditions are satisfactory for production of quality work. Report to Consultant in writing any surfaces which are found to be unsatisfactory. Commencement of work shall imply acceptance of substrate surfaces.
- 3.1.2. Ensure temperature of surfaces to be finished is between 10 and 20 deg C (50 and 68 deg F) and surfaces are dry and free of dirt, grease or other contaminants that may affect applied finish.
- 3.1.3. Verify moisture content of surfaces with electronic moisture metre. Do not proceed without written directions if moisture reading is higher than 12-15%.
- 3.1.4. If substrate is gypsum board, inspect to ensure joints are completely filled and sanded smooth. Inspect surfaces for "nail popping", screw heads not recessed and taped, breaks in surface or other imperfections and have repaired as required.

2.2 PREPARATION

2.2.1 Protection

- 2.2.1.1 Provide scaffolding, staging, platforms and ladders, as required for execution of work. Erect scaffolding to avoid interference with work of other trades. Comply with Occupational Health and Safety Act.
- 2.2.1.2 Provide drop cloths or adequate plastic sheets to protect floors in areas assigned for storage and mixing of paints.
- 2.2.1.3 Remove finish hardware, electrical switch and outlet covers to protect from paint splatter. Mask items not removable. Use sufficient drop cloths and protective coverings for full protection of floors, furnishings, mechanical, electrical and special equipment, all other components of building which do

not require painting or to be removed, from paint spotting and other soiling. Re-install items when paint is dry. Clean any components that are paint spotted or soiled.

2.2.1.4 Keep waste rags in covered metal drums containing water and remove from building at end of each day.

2.2.1.5 Prohibit traffic, where possible, from areas where painting is being carried out and until paint is cured. Post "wet paint" or other warning signage during and on completion of work.

2.2.1.6 When handling solvent coating materials, wear approved vapour/particulate respirator as protection from vapours. Dust respirators do not provide protection from vapours.

2.2.2 Surface Preparation

Remove dust, grease, rust and extraneous matter from surfaces (except rust occurring on items specified to be primed under other Sections shall be removed and work reprimed under those Sections).

2.2.2.1 Gypsum Board: Examine surfaces after for imperfections showing through and fill small nicks or holes with patching compound and sand smooth. Examine surfaces after priming for imperfections showing through. Clean surfaces dry, free of dust, dirt, powdery residue, grease, oil, wax or any other contaminants. Sand and dust as necessary prior to painting.

2.2.2.2 Woodwork for Painting: Seal all knots and sapwood in surfaces to receive paint with alcohol-based primer-sealer. Sand smooth rough surfaces of all woodwork to be finished and clean surfaces free of dust before applying first coat. Fill nail holes, splits and scratches with non-shrinking filler after first coat is dry. Remove salt deposits that may appear on wood surfaces treated with fire retarder.

2.2.2.3 Woodwork for Clear Finish or Stain: Sand smooth all woodwork to be finished and clean surfaces free of dust before applying first coat. Abrade surfaces with stiff brush to remove loose fibres and splinters. Fill nail holes, splits and scratches with non-shrinking filler tinted to match local grain condition after first coat is dry. Sand lightly between coats with No. 220 sandpaper and remove dust. Remove salt deposits that may appear on wood surfaces treated with fire retarder.

2.3 APPLICATION

2.3.1 Provide finish uniform in sheen, colour and texture, free from streaks, shiners and brush or roller marks or other defects.

2.3.2 Apply materials in accordance with manufacturer' directions and specifications. Do not use adulterants. Any reduction of coating's viscosity shall be done in accordance with manufacturer's directions.

2.3.3 Finish listed surfaces indicated on Room Finish Schedule(s) and/or noted on

Drawing(s) and as specified hereunder.

- 2.3.4 Finishes and number of coats specified hereinafter in Finish Schedule are intended as minimum requirements guide only. Refer to manufacturer's recommendations for exact instructions for thickness of coating to obtain optimum coverage and appearance. Some materials and colours may require additional coats and deeper colours may require use of manufacturers' special tinted primers. Unless otherwise specified, provide Premium (3 coats) finish as defined by OPCA as minimum finish.
- 2.3.5 Obtain colour chart giving colour schemes and gloss value for various areas from Consultant. Colour chart shall give final selection of colours and surface textures of all finishes, and whether finishes are transparent (natural) or opaque (paint).
- 2.3.6 Spraying not allowed without written permission.
- 2.3.7 Paint entire plane of areas exhibiting incomplete or unsatisfactory coverage and of areas, which have been cut and patched. Patching not acceptable.
- 2.3.8 Do not paint baked enamel, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory. Finish paint all primed surfaces.
- 2.3.9 Advise Consultant when each applied paint coat can be inspected. Do not recoat without inspection. Tint each coat slightly to differentiate between applied coats.
- 2.3.10 Sand smooth enamel and varnish undercoats prior to recoating.
- 2.3.11 Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.
- 2.3.12 Prime woodwork designated for painting as soon as possible after delivery to Site and before installation. Prime all cut surfaces, whether exposed or not, i.e. all six edges of wood doors, before installation. Prime all cut surfaces of woodwork to receive transparent finish with 1 coat of transparent finish reduced 25%.
- 2.3.13 Fill open grain woods with filler tinted to match wood and work well into grain. Wipe excess from surface before filler sets.
- 2.3.14 Apply primer-sealer coats by brush or roller. Permit to dry in accordance with manufacturer's recommendations before applying succeeding coats. Touch up suction spots and sand between coats with No. 120 sandpaper.
- 2.3.15 Apply final coats on smooth surfaces by roller or brush. Hand brush wood trim surfaces.

2.4 CLEANING

- 2.4.1 Upon completion, remove masking and clean adjacent surfaces free of overspray spatters, drips, smears and overspray.

2.5 DISPOSAL OF PAINT WASTE

- 2.5.1 Be responsible for removal and disposal of material and waste generated by this Section.
- 2.5.2 Remove empty and partly used containers from Site and recycle or dispose of as Hazardous Waste in accordance with local municipal, provincial and federal environmental regulations. Provide proof of such action in form of receipts of tipping fees, disposal fees or bills of lading, as applicable.
- 2.5.3 Remove from site peripheral items, such as clean up solvents, paint brushes, rags, and similar items and dispose of where necessary in accordance with local municipal, provincial and federal environmental regulations.
- 2.5.4 Do not rinse off of latex paints from brushes and rags under running water tap. While work is ongoing, whether using latex or alkyd products, rinse off all brushes and rags in container with appropriate solvent (water or paint thinner). Leave such container in well lit and well ventilated area, away from any flammable conditions. Dispose of emulsion created in accordance with local municipal, provincial and federal environmental regulations.

2.6 INTERIOR FINISH SCHEDULE

2.6.1 Gypsum Board Surfaces

INT 9.2M

1 Latex Primer Sealer MPI 50

2 coats Institutional low odor/VOC acrylic latex coating, Gloss/Sheen: eggshell, MPI 143, 144, 145, 146, 147, 148 – confirm with Facility

2.6.2 Steel, unprimed - HM Doors, Frames and Screens, misc. metals etc.:

INT 5.1S

1 coat, rust inhibitive primer MPI 107

2 coats Institutional low odor/VOC MPI 143, 144, 145, 146, 147, 148

Gloss level – satin, confirm with facility

2.6.3 Steel, unprimed - Base Plates:

INT 5.1B

1 coat Rust Inhibitive Primer MPI 107

2 coats of selected sheen, W.B. Light Industrial Coating MPI 151, 153, 154

2.6.4 Concrete Block

INT 4.2E

Latex block filler to produce 100% filled surface MPI 4

- 3 coats Institutional Low Odor/VOC MPI 143, 144, 145, 146, 147, 148. Satin finish – to be confirmed with facility.

3.2.1 Woodwork, millwork & trim, wood doors to receive transparent finish

1 coat paste wood filler natural
2 coat satin polyurethane varnish
or

Woodwork, millwork & trim, wood doors to receive stained finish

1 coat paste wood filler natural
1 coat transparent wood stain – to match plastic laminate colour
2 coat satin polyurethane varnish

3.2.2 Woodwork, trim to receive paint finish:
1 coat latex undercoater primer/sealer
2 coats latex paint of selected sheen

3.2.3 Intumescent Paint for Fire-Retardant Plywood:
1 coat 10-10A @ 230sqft/gal; ULC Class 'A', Flat, Solvent Based
Flame Control Coatings or equal.

3.3 EXTERIOR FINISH SCHEDULE

3.3.1 Steel, over Alkyd Primer - HM Doors, Frames and Screens, misc. metals, OH Doors, etc.

EXT 5.1D
1 coat, alkyd metal primer MPI 79
2 coats Alkyd MPI 8, 9, 94

3.3.2 Wood Fence
2 coats Semi-Transparent Stain

3.4 COLOUR SCHEDULE

3.4.1 Colour of all surfaces shall match existing paint colours where wall or ceiling finishes are disturbed as a result of new work.

3.4.2 Colours are as follows:
Main, PT-1: CC-10 Ultra White
Accents;
PT-2: 21111-50 Stone Harbor
PT-3: CC-544 Overcoat
PT-4: CC-932 North Sea

HM Doors and Frames – CC-544 Overcoat

Provide exterior stain colours for selection by Consultant.
All colours by Benjamin Moore

3.5 Field Quality Control/Standard of Acceptance

3.5.1 All surfaces, preparation and paint applications shall be reviewed by Consultant.

- 3.5.2 Painted exterior and interior surfaces shall be considered to lack uniformity and soundness if any of the following defects area apparent to the Owner or Consultant:
- 3.5.2.1 brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas and foreign materials in paint coatings.
- 3.5.2.2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
- 3.5.2.3 Damage due to touching paint before paint is sufficiently dry or any other contributory causes.
- 3.5.2.4 Damage due to application on moist surfaces or caused by inadequate protection from the weather.
- 3.5.2.5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.)
- 3.5.3 Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:
- 3.5.3.1 Visible defects are evident on vertical surfaces when viewed at normal viewing angles form a distance of not less than 1000 mm (39").
- 3.5.3.2 Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").
- 3.5.3.3 Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
- 3.5.3.4 When the final coat on any surface exhibits a lack of uniformity of colour, sheen texture and hiding across full surface area.
- 3.5.4 Painted surfaces rejected by Consultant shall be made good at the expense of the Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

End of Section

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 Conform to Sections of Division 1 as applicable.
- .2 Refer to Section 08 34 20 Security Doors, Frames and Screens. Section 11 19 10 Sliding Cell Doors, Screens and Equipment to be shop painted by security door fabricator off site with epoxy paint as specified.

1.2 QUALITY ASSURANCE

- .1 Perform work of this Section by applicator with minimum 5 years of proven, satisfactory and successful experience on projects of similar size and nature installing the epoxy wall coating as specified. Submit proof of such experience with list of projects in Canada upon Consultant's request. Provide qualified crew and full time review of work by qualified supervisor for duration of work.
- .2 As work progresses and upon completion of work, submit written reports and manufacturers' confirmation that materials and application methods conform to manufacturers' requirements.
- .3 Coordinate work of this Section with work of Section 09 67 23 –Epoxy Flooring. Ensure compatibility of floor and wall finish products where they come into contact. Coordinate installation to provide neatly finished overlap where floor and wall coatings meet

1.3 SUBMITTALS

- .1 **Product Data:** Submit 100 mm x 100 mm (4" x 4") sample of wall coating applied to rigid backing, in colour and finish indicated. Manufacturer's technical data, installation instructions and general recommendations for coating system.
- .2 Submit maintenance manuals in accordance with Section 01 33 00, Submittals and 01 71 00 Execution Requirements, containing specific instructions for maintenance, preservation and cleaning. Provide adequate warning of maintenance materials or practices which may be detrimental to flooring.
- .3 Submit manufacturer's **environmental product declaration** for inclusion in the Close-out Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to Site in original, unopened containers with manufacturer's labels and seals intact. Labels shall identify manufacturer's name, brand name of product, grade and type, application directions and shelf life and/or expiry date of product.
- .2 Handle and store materials in accordance with manufacturer's printed directions.
- .3 Store flammable materials in safe, approved containers to eliminate fire hazards and remove from Site at end of each work shift.
- .4 Do not use materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.5 PROJECT CONDITIONS

- .1 Environmental Requirements
 - .1 Ensure substrates are prepared to manufacturer's requirements and cured a minimum of 28 days. Substrates must be approved by manufacturer for specified product.
 - .2 Maintain minimum air and surface temperatures at 16 deg C (60 deg F) for 24 hours before, during, and for 48 hours following application, or until cured.
 - .3 Maintain well-lit and well-ventilated area.
 - .4 Comply with coating manufacturer's directions for maintenance of substrate temperatures, ventilation and other conditions required to execute and protect work.

1.6 ENVIRONMENTAL REQUIREMENTS

- .1 Safety.
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of materials.
 - .2 Ensure no open flame heating devices are used.
 - .3 Discourage occupancy of treated space until volatile materials are no longer being emitted and there is no odour.
 - .4 Provide adequate respiratory protection to exposed individuals and as recommended by manufacturer.
- .2 Ventilation.

- .1 Provide ventilation continuously during and after coating application. Run system 24 hours per day during application; provide continuous ventilation for 7 days after completion of application.
- .2 Ventilate enclosed spaces.
- .3 Temperature.
 - .1 Do not apply emulsion systems unless uniform minimum 16°C air temperature at installation area for 24 hours prior to and after application.
 - .2 Maintain minimum temperature 10 °C within area of installation until final acceptance of building.

Part 2 Products

2.1 MATERIALS

- .1 Epoxy wall coating: high solids, 2-part, low odour, thermosetting cold cure epoxy high build coating, high impact and abrasion resistance; 2 coats application for minimum DFT of .38 mm (15 mils) conforming to CAN/CGSB-1.153M or CFSB-1-GP-146M. Finish: glossy
 - .1 Acceptable Products:
 - .1 Epoxal – Niagara Protective Coatings Ltd.
 - .2 Sikagard Duroplast-100 N – Sika Canada Inc.
 - .3 Stonglaze VSE – Stonhard Ltd.
 - .4 Cophard EM & ES – Coppar Ltd.
 - .5 Liquitile BF-1 – Tremco Canada Ltd.
 - .6 Everpoxy – Everspec Surfaces
 - .2 **Colours:** As selected by Consultant from manufacturer's standard range.
Colour to be approved by Client
 - .3 Sealant: Refer to Section 07 92 00 Sealants – non-pick epoxy sealant required to seal all projections coming through wall coating. Coordinate work to ensure all caulking at joints are sealed prior to application of coating.
 - .4 Primer: As recommended by wall coating manufacturer.
 - .5 Block filler: as recommended by wall coating manufacturer and suitable for anticipated conditions. In areas of high humidity, use epoxy block filler only.

2.2 MIXES

- .1 Mix coatings according to manufacturer's instructions.

Part 3 Execution

3.1 PREPARATION

- .1 Prepare surfaces in accordance with coating material manufacturer's instructions.

□

- .2 Mask surrounding surfaces to provide neat, clean juncture lines.
- .3 Protect adjacent surfaces and equipment from damage by overspray.

3.2 APPLICATION

- .1 Apply coating to produce smooth surface, uniform in sheen, colour and finish, free from marks, dirt, particles, runs, crawls, curling, holes, air pockets and other defects and to achieve smoothness index in accordance with manufacturer's recommendations. The coating shall produce a monolithic wearing surface of minimum thickness required by manufacturer.
- .2 Allow proper curing time between coats as recommended by manufacturer. Protect surface from damage during this time.

3.3 CLEANING

- .1 Clean surfaces to coating manufacturer's printed instructions.

3.4 LOCATIONS

- .1 Secure Area Walls & Benches where noted.
- .2 Steel components of Security Doors, Sliding Cell Doors, Frames and Screens.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this Section and shall apply as if repeated here.

1.2 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 01300 – Submittals.

1.3 MAINTENANCE MANUALS

1. Provide maintenance brochures for insertion in maintenance manual in accordance with Section 01300 – Submittals.

1.4 SCOPE

1. Provide whiteboards at all locations where indicated on the drawings.

PART 2 PRODUCTS

2.1 MATERIALS

1. Whiteboards: 1200mm x 1200mm “Rite-on, Wipe Off” Vit-Rite boards by Architectural School Products. The board surface shall be porcelain enamel on steel. Locate as indicated on the plans and interior elevations.
2. Plywood: Fir Plywood conforming to C.S.A. 0121.
3. Trim: Series 200 extruded aluminum trim, 2 3/4" (69.9 mm) marker trays and display rails, Model 206, as manufactured by Architectural School Products Ltd. Finish to be clear anodized aluminum. Marker tray to be #No. 212 with end caps. Marker tray to be full length. Where more than one whiteboard is installed continuously, each whiteboard will have its own individual trim, and marker tray complete with end caps.
4. Marker Pens for Markerboards: Dry Erase Marker Pens as supplied by Architectural School Products or Equal 4 Colours - Black, Purple, Green, and Red. Provide 10 boxes of 4 assorted markers in each box and 10 boxes of black markers with 4 in each box. Dry Erase Marker Pens for Owner's start up.
5. Adhesive: Type recommended by whiteboard manufacturer.

2.2 APPROVED EQUAL MANUFACTURER'S:

1. Global School Products Inc.

2. Cveti Products Inc.

PART 3 EXECUTION

3.1 INSTALLATION

1. Install whiteboards in sizes and locations indicated on drawings all in accordance with manufacturer's directions. Review heights of whiteboards with Architect and Owner prior to installing. Coordinate installation to avoid conflict with any adjacent millwork.
2. Do not set whiteboards until final coat of wall finish has dried. Confirm mounting height with architect / owner.
3. All whiteboard units shall be equipped with marker trays.
4. Mitre corners of trim with tight fitting hairline joints.
5. Mechanical Attachment Only:
 1. To concrete or solid masonry use lag screw and expansion bolts, or screws and fibre plugs as appropriate for stresses involved.
 2. To hollow masonry, use toggle bolts or equivalent.
 3. To wood or sheet metal use screws secure into framing members in stud walls.
 4. Do not adhere tackboards to any walls.

3.2 CLEANING AND BREAKING-IN WHITEBOARD SURFACES

1. Upon completion, clean whiteboard surfaces and leave in perfect ready-to-use condition.
2. Advise client on proper markers and cleaning procedures to use with whiteboards.

END OF SECTION

**SECTION 10 14 53
TRAFFIC SIGNAGE**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS (N/A)

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, (5th Edition).
- .2 ASTM International
 - .1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A276-10, Standard Specification for Stainless Steel Bars and Shapes.
 - .3 ASTM B209M-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .4 ASTM B210M-05, Standard Specification for Aluminum-Alloy Drawn Seamless Tubes (Metric).
 - .5 ASTM B211M-03, Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire (Metric).
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 62-GP-9M-80, Prefabricated Markings, Positionable, Exterior, for Aircraft Ground Equipment and Facilities.
 - .2 CGSB 62-GP-11M-78, Marking Material, Retroreflective, Enclosed Lens, Adhesive Backing and Amendment.
- .4 CSA Group (CSA)
 - .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA O80 Series-08, Wood Preservation.
 - .3 CSA O121-08, Douglas Fir Plywood.
 - .4 CSA W47.2-11, Certification of Companies for Fusion Welding of Aluminum.
 - .5 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 Green Seal Environmental Standards (GS)
 - .1 GS-11-11, Paints and Coatings.

- .7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2011, Architectural Coatings.
- .8 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2010-2014 Standard.
- .9 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual-current edition.

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 traffic signage, including 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 Ontario, Canada.

1.5 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 in a dry location 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 DESIGN CRITERIA

- .1 Structural deflections and vibration in accordance with American Association of State Highway and Transportation Officials (AASHTO), "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals".

2.2 MATERIALS

- .1 Sign supports:
 - .1 Steel posts: to CSA G40.21, 4 m long, flanged "U" shaped in cross section, measuring 65 mm wide x 30 mm deep. Metal thickness: 4.5 mm. Hot dipped galvanized: to ASTM A123/A123M, minimum zinc coating 600 g/m².
 - .2 Standard tubular supports for small signs: to ASTM B210M
 - .3 Timber posts:
 - .1 Sawn timber posts:
 - .1 Species: SPF.
 - .2 Type: pressure treated.

- .3 Grade: No. 1/2.
- .4 Dimensions: as indicated.
- .5 CAN/CSA-Z809 or FSC or SFI certified
- .4 Vertical tubular supports and connecting diagonal members: to ASTM B210M
- .5 Truss members: to ASTM B210M
- .6 Aluminum tubular members: belt ground satin finish.
- .7 Base plates for ground mounted signs: to ASTM B209M. Base plates for overhead supports: to ASTM B209M
- .8 Tubular support caps for ground mounted signs: to ASTM B210M or fabricated from aluminum plate as specified in ASTM B209M. Castings for overhead signs: to ASTM B211M
- .9 Aluminum flanges: to ASTM B211M
- .10 Anchor and connecting bolts, 'U' clamps and miscellaneous hardware for overhead sign installations: fabricate from 304 stainless steel as specified in ASTM A276
- .11 Fasteners: bolts, nuts, washers and other hardware for roadside signs to be cast aluminum alloy, or galvanized steel.
- .2 Signboards:
 - .1 Plywood: to CSA O121, 19 mm thick. Overlaid Douglas Fir, Medium Density CAN/CSA-Z809 or FSC or SFI certified, overlaid one side only with fibre or plastic sheet surfacing material
 - .2 Aluminum sheet: to ASTM B209M, precut to required dimensions
 - .1 Thickness for signboards up to 750 mm wide: 1.6 mm minimum.
 - .2 Thickness for signboards 750-1200 mm wide: 2.1 mm minimum.
 - .3 Thickness for refurbishing existing sign panels: 1.0 mm minimum.
 - .3 Aluminum extrusions: to ASTM B211M, 150 mm or 300 mm panels suitable for bolting together.
 - .4 T-shape stiffeners for signboards: to ASTM B210M
 - .5 Connecting straps and brackets: to ASTM B209M
 - .6 Aluminum materials: to ASTM B209M
 - .7 Xylene thinner: to 15%
 - .8 Primer for plywood: to MPI #5 VOC limit of 350 g/L to SCAQMD Rule 1113.
 - .9 Chemical conversion coating for aluminum: Chromate Conversion Coating / Chem Film / Alodine.
 - .10 Primer for aluminum: to MPI # 8, VOC limit of 250 g/L to GS-11.
 - .11 Silk screen ink:
 - .1 Transparent or opaque colours: selected by department representative, or as indicated.
 - .12 Reflective sheeting and tape: to CGSB 62-GP-11M. Adhesive, class of reflectivity and colour as indicated.

- .13 Transparent tape: flexible, smooth-surfaced, moisture resistant tape with pressure sensitive adhesive.
- .14 Clear varnish protective coat: MPI-EXT 6.4H VOC limit of 350 g/L to SCAQMD Rule 1113.

2.3 FABRICATION

- .1 Supports:
 - .1 Connect aluminum support members by welding in accordance with CSA W47.2. Work to be performed by Canadian Welding Bureau qualified members only. Flame cutting of members not permitted
 - .2 Welds to be of same strength as adjacent member or casting.
 - .3 Reinforce in area of electrical hand holes to equal strength of full section member.
 - .4 Remove sharp edges and burrs.
- .2 Signboards:
 - .1 Plywood blanks:
 - .1 Cut plywood blanks to required shapes and dimensions. Fill edges with wood filler suitable for outdoor use and sand smooth.
 - .2 Lightly sand surfaces, wipe clean with xylene thinner and allow to dry for 8 hours.
 - .3 Spray signboard back and edges with one prime coat maximum VOC content 350 g/L to GS-11 and two white finish coats maximum VOC content 350 g/L to GS-11 in the same colour as the sign face.
 - .2 Aluminum blanks:
 - .1 Degrease, etch and bonderize with chemical conversion coating.
 - .2 Clean surfaces with xylene thinner. Dry.
 - .3 For non-reflective signs, spray face with one coat vinyl pretreatment coating and two finish coats of required colour.
 - .4 For aluminum signboards that are to be painted before installation, spray and bake face of signboards with two coats of enamel in accordance with MPI-EXT 5.4A.
 - .3 Reflective background sheeting and lettering:
 - .1 Cut and apply in accordance with manufacturer's instructions.
 - .2 Apply adhesive coated material with heat lamp vacuum applicator or by squeeze roll application method. Apply pressure sensitive material with roller or squeegee.
 - .3 Edge wrap sheeting on each extrusion prior to bolting extrusions. Match pieces of sheeting from different rolls for each signboard to ensure uniform appearance and brilliance by day and night.
 - .4 Reflective signboard faces may be prepared using silk screen transparent ink.
 - .4 Non-reflective lettering and symbols: cut from vinyl film as specified in CGSB 62-GP-9M, or paint using required colour of finish paint maximum VOC of 350g/L to GS-11 or silk screen transparent ink.

- .5 Clean signboards completely and apply transparent tape over top edge and extending 25 mm minimum down back and front of signboard.
- .6 Protect finished signboard faces with one coat of clear varnish with maximum VOC limit of 350 g/L.
- .7 Apply two coats of white paint with maximum VOC content of 50 g/L to GS-11 to wooden sign posts. Allow initial coat to dry before applying second coat. Apply paint only when relative humidity is below 85% and ambient temperature is above 5 degrees C.
- .3 Sign identification:
 - .1 Apply sign number and date of installation with 25 mm high stencil painted black letters on lower left back face of each signboard.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Sign bridge:
 - .1 Erect sign bridge as indicated. Permissible tolerance: 12 mm maximum departure from vertical.
- .2 Sign support:
 - .1 Erect supports as indicated. Permissible tolerance: 50 mm maximum departure from vertical for direct buried supports. Where separate concrete footings have been placed, erect posts with base plates resting on levelling nuts and restrained with nuts and washers. Permissible tolerance: 12 mm maximum departure from vertical.
 - .2 Coat underside of base plate with corrosion protective paint before installation. Connect shoe base to shaft with inside and outside fillet welds.
 - .3 Close open aluminum tubes and posts with aluminum cap. Cut oblong holes in shoe bases to drain condensation. Install aluminum bolt cover on each base plate restraining nut.
 - .4 Erect posts plumb and square to details as indicated.
 - .5 Single channel steel posts:
 - .1 Drive to required depth without damage to posts.
 - .2 If rock or concrete is encountered, drill hole to required depth and set post in sand.
 - .3 In finished concrete surfaces, backfill with concrete or grout. Protect from adverse conditions until cured.
 - .6 Wooden post installation:
 - .1 Excavate post holes to 300 mm minimum diameter. Compact bottom of hole to provide firm foundation. Set post and backfill in 150 mm layers with excavated material. Compact each layer before placing each subsequent layer.
 - .2 Leave or make depression, approximately 150 mm deep, around posts until paint is dry, then backfill and compact with excavated material to ground elevation.
 - .7 Join truss sections with wrought aluminum flanges welded to chords with inside and outside fillet welds. Build in camber to truss and monotube bridge supports

to allow for deflection due to dead load of sign support, signboards, appurtenances; and an additional 1:300 camber.

- .3 Signboard:
 - .1 Fasten signboards to supporting posts and brackets as indicated.
 - .2 Fasten lane markers to signboard.
 - .3 Use T-shape aluminum stiffeners to join portions of sign panel on site. Cover face of T-stiffener with material identical to face of sign panel.

3.2 CORRECTING DEFECTS

- .1 Correct defects, identified by departmental Representative, in sign message, consistency of reflectivity, colour or illumination. Correct angle of signboard and adjust luminaire aiming angle for optimum performance during night conditions to approval of department representative.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by traffic signage installation and salvage operations.

END OF SECTION

1. GENERAL:

1.1 General Requirements

1.1.1 Conform to Sections of Division 1, as applicable.

1.2 Related Work Specified Elsewhere:

1.2.1 Washroom Accessories: Section 10 80 00

1.3 Shop Drawings

1.3.1 Submit shop drawings in accordance with Section 01 33 00 Submittals, clearly indicating compartment layouts, dimensions, plans, elevations, the material being supplied and all connections, attachments, reinforcing, anchorage, hardware and location of exposed fastenings.

1.3.2 Submit necessary templates and instructions where supports or anchors have to be built in by others.

1.3.3 Operations and Maintenance Data

1. At completion of the job, furnish to the owner (2) copies of an Owners Operation and Maintenance Manual. The Manual shall consist of a hard cover three ring binder with the project name in the front. Include in the manual the following information: Maintenance instructions, Catalogue pages for each product, Name/Address and phone number of the Manufacturer and their Sales Agent, Copy of the final shop drawings.

1.4 QUALITY ASSURANCE

1.4.1 Substitutions

1. Manufacturers and model number listed are to establish a standard of quality. Similar items by approved manufacturers that are equal in design, function, quality and finish may be accepted upon prior written approval from the Architect/Owner.

2. All requests for acceptable substitutions must be made in writing and submitted to the Architect at least 14 days prior to tender closing. If requested, all requests for substitutions must be accompanied by product literature and actual product samples.

**STAINLESS STEEL TOILET
PARTITIONS**

-
- 1.4.2 **Supplier Qualifications**
1. Toilet Partition shop drawings and Toilet Partitions shall be procured from a source of supply approved by the Consultant/Owner/Architect. Supplier is responsible for the complete Toilet Partition subcontract.
- 1.5 **DELIVERY, STORAGE AND HANDLING**
- 1.5.1 **Marking and Packaging**
1. Toilet Partitions must be delivered to the job site in the manufacturers' original packages and marked to correspond with the approved shop drawings.
- 1.5.2 **Delivery**
1. Toilet Partitions must be delivered in an amount of time deemed appropriate by the Consultant/Owner.
- 1.6 **WARRANTY**
- 1.6.1 **Written Guarantee**
1. The Toilet Partition manufacturer shall guarantee all Toilet Partitions by written certification, for a period of (5) years from date of certified substantial performance of the project, against any defects in design, materials and workmanship. Any defects as described will be made good by the manufacturer at no additional cost to the owner.
- 1.7 **MAINTENANCE**
- 1.7.1 **Maintenance**
1. Upon request, at completion of the project, the Toilet Partition supplier may be required to brief Owner's maintenance staff regarding proper care of Toilet Partitions, such as: required lubrications, adjustments, cleaning, etc.
- 2 PRODUCTS**
- 2.1 **Materials:**
- 2.1.1 **Stainless Steel Toilet Compartments, Maximum Privacy, Overhead Braced and Floor mounted with increased privacy, and heavy duty continuous stop and sight line fillers.**
- .1 **Construction:** Doors, Panels and Pilasters shall be constructed of two sheets of type 304, Embossed stainless steel with 5WL® pattern, laminated under pressure to (1/2") honeycomb core for impact resistance, rigidity and sound deadening. Formed edges to be welded together and interlocked, under tension, with a roll-formed oval crown stainless steel locking bar, mitred, welded and ground smooth at the corners. Honeycomb to be of virgin, long fiber paper

with a maximum 12.5mm (1/2") cell size.

.2 Doors: Shall be 25mm (1") thick with cover sheets not less than 22-gauge (0.8mm). All doors are 1626 mm (64") high. Mounted 152 mm (6") above the floor

.3 Panels (including urinal screens): Shall be 25mm (1") thick with cover sheets not less than 22-gauge (0.8mm); 20-gauge (0.9mm) available upon request. All panels are 1626 mm (64") high. Maximum panel depth is 1473 mm (58"). Urinal screens to be wall mounted and 1067 mm (42") high.

.4 Pilasters: Shall be 32mm (1.25") thick with cover sheets not less than 22-gauge (0.8mm). Pilaster tops shall be reinforced with 20-gauge channel to create extra strength and twist-free rigidity along with minimizing damage by handling and/or shipping.

.5 Hardware and Fittings: All panel-to-pilaster, panel-to-wall and pilaster-to-wall connections shall be made with full height continuous channels. All door hardware shall be chrome plated zinc die castings, standard. Fasteners are 12 x 1-3/4" and 12 x 5/8" TR-27 6-lobe security screws. Doors shall be equipped with a gravity type hinge mounted on the lower pilaster hinge bracket. Door hinges shall be wrap-around style and adjustable to permit the door to rest at any position when not latched. Each door to be fitted with a combined coat hook and bumper and a concealed latch, with face mortised flush with edge strip of door. Barrier-free doors shall include thumbturn lever to activate latch without fingertip grip application. Both standard and barrier-free latches shall have a turn slot designed to allow emergency access from exterior. The combined full length extruded aluminum door stop and keeper shall have a 1/4" wide continuous rubber bumper locked in place the length of the stop. To cover the sightline gap at door hinge side, full length extruded aluminum filler channel shall be provided. The "no sightline" continuous stop and hinge filler shall be #4 brushed to match door and pilaster finish. Threaded upper hinge pin shall have a metal core and self-lubricating nylon sleeve to ensure smooth, quiet operation. Pilaster shoes shall be a welded one-piece design made from polished stainless steel. Two-piece shoes that can disassemble when kicked are unacceptable.

2.1.2 Acceptable Manufacturer: Hadrian Manufacturing Inc., Elite Series or equal.

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- 2.2 Fabrication
- 2.2.1 Fabricate doors and partition panels and pilasters, 25 mm thick, sizes as indicated. Urinal screens, 610 mm (24") deep, 1067 mm (42") high. Urinal screens located where indicated on drawings.
- 2.2.2 Doors opening shall be minimum for a Barrier-Free Door opening and must comply with the latest edition of the OBC.
- 3 EXECUTION**
- 3.1 Partition Erection
- 3.1.1 Install partitions secure, plumb and square, in strict accordance with manufacturer's printed instructions.
- 3.1.2 Anchor fixing brackets to masonry-concrete surfaces using screws and shields: to hollow walls using bolts and toggle type anchors, to steel supports with bolts in threaded holes. Sleeve floor anchors minimum 50 mm into concrete.
- 3.1.3 Attach panel and pilaster to brackets with through type sleeve bolt and nut.
- 3.1.4 Equip each door with hinges, latch set, and coat hook. Adjust and align hardware for proper function. Set door open position at 15 deg. to front.
- 3.1.5 Set doors approximately 305 mm above finished floor.

***** END *****

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.1.1 Refer to the Drawings for location of vertical acoustic room divider to be supplied and installed under this Section.

Supply and installation of Automatic Vertically Retractable Acoustical Wall(s) as shown on the architectural drawings. Include all necessary hardware, seals, lifting machinery, electrical controls and other components to ensure proper operation and function.

1.2 RELATED SECTIONS

- 1.2.1 The General Contractor shall include all related and ancillary work to include a fully operational installation, including but not limited to:
- 1.2.2 The main support steel beam for the wall, as well as the miscellaneous support steel for the lifting machinery for the Automatic Vertically Retractable Acoustical Wall.
- 1.2.3 Ceiling storage pockets along axis of Automatic Vertically Retractable Acoustical Wall.
- 1.2.4 Bulkheads and sound insulation above, below, and in the fixed walls at both ends of the Automatic Vertically Retractable Acoustical Wall.
- 1.2.5 All site wiring and connections for main power, including disconnect switches at each motor location. All site wiring and connections for control, including installation of key switches

1.3 SUBMITTALS

1.3.1 Shop Drawings

- 1.3.2 Submit shop drawings in accordance with Section 01 33 00 Submittals.
- 1.3.3 Verify dimensions on the Site before preparing drawings or proceeding with shop work.
- 1.3.4 Submit manufacturers' technical data.
- 1.3.5 Submit shop drawings showing complete layout of operable wall system based on field verified dimensions. The drawings shall include dimensional relationship to adjoining work. Include details indicating materials, finishes, tolerances, and methods of attachment to building steel and electrical requirements
- 1.3.6 Submit certified test reports evidencing compliance to acoustical STC (Rw) requirements.
- 1.3.7 Include details of recesses, bulkheads, trim, end panels, gauges of materials, methods of installation and fastening, supports/brackets and any other requirements to ensure incorporation into the building and proper operation and conformance with Post-Disaster requirements.
- 1.3.8 Job check dimensions where work is installed against finished surfaces.

1.4 REFERENCES

- 1.4.1 ASTM E90, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions (Annex A1.15).
- 1.4.2 ASTM E413, Classification for Rating Sound Insulation.
- 1.4.3 ISO 354, Measurement of Sound Absorption.
- 1.4.4 ISO 140-3, Measurement of Airborne Sound Insulation.
- 1.4.5 ASTM C423, Measurement of Sound Absorption.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 Following manufacturers are acceptable provided that they conform to every other requirement of these Specifications:

Acceptable Manufacturers
SkyFold.

Or approved equal.

- 2.1.2 Consultant will not accept changes to manufacturer's products without prior notification in sufficient time to evaluate effects of such changes prior to tender closing date.
- 2.1.3 Where a manufacturer's standard product line does not fully meet specified requirements in every characteristic it is intended that manufacturer will upgrade his product to required standard to qualify as a supplier or will refrain from bidding.
- 2.1.4 System Description: Automatic Vertically Retractable Acoustical Wall (from here on called Operable Wall) shall refer specifically to acoustical operable walls that, when in the down position (closed) are hard, rigid, flat, plumb walls, made of a grid of rectangular acoustical panels, and when are lifted (opened), fold upward (vertically) without the use of any manual labor, in a manner similar to an accordion, into a pocket in the ceiling, between roof joists, or up between built in bulkheads. In the down (closed) position, the wall shall be comprised of two vertical planes of acoustical panels, separated by an acoustical air space.
- 2.1.5 The operable wall shall open and close in a manner similar to an accordion, in that all wall panels fold and unfold at the exact same time, at the exact same rate.
- 2.1.6 Standard Drive System: The motor drive assembly shall be mounted directly above the centre line of the operable wall. Provide support as required.
- 2.1.7 Operation: The operable wall shall be opened and closed, in the standard scenario, using two push button switches wired in series with power controlled by a single, three position key switch, Or, in the optional scenario, using two touch screen operator stations. In the standard, push button scenario, turning the key from the "off" position shall cause the wall to move in the designated direction "up" or "down" once both push buttons are depressed. In the optional, touch screen scenario, pressing and holding the up or down directional arrow symbol on one touch screen while simultaneously pressing and holding the button symbol on the second screen shall cause the wall to move in the selected direction. In both scenarios, when hand pressure is removed, the wall shall immediately stop. The operable wall shall stop in a quick and positive fashion without coasting. As a

normal part of the operation, it shall be possible to partially open (or close) the wall, stop it and then reverse the operation. There shall be two (2) switches per operable wall, located on opposite sides of the wall at opposite ends of the wall, wired in series. In the standard condition, one switch shall be equipped with an LED that flashes fault codes in case of a failure with the electrical system. In the optional, touch screen scenario, the screens will display faults in case of a failure with the electrical system.

- 2.1.8 Operational Requirements: From a fully open position, the operable wall shall be able to go through its entire cycle of closing and/or opening without any manual intervention. When the operable wall is being lowered (closed) it shall come automatically to rest once it has reached the fully down (closed) position. When the operable wall is being lifted (opened) it shall come automatically to rest once it has reached the fully up (open) position. The operable wall shall automatically and acoustically seal against the floor without the need for any manual intervention. The floor seals shall leave a joint between the floor and the bottom acoustical panels of not more than approximately 2" (51 mm). The operable wall shall automatically and acoustically seal against the two end walls without the need for any manual intervention. The end seals shall act in such a way as not to come into contact with the end walls while the operable wall is in motion. The end seals shall leave a joint between the acoustical panels and the end walls of no more than approximately 1" (25 mm). Seals that rub or brush against the end walls are not acceptable. Once the wall reaches the full down position, the end seals shall activate automatically. The key switch does not need to be held during the deployment of the end seals. The operable wall shall automatically and acoustically seal against the ceiling without any manual intervention. The top seals shall leave a joint between the top acoustical panels and the ceiling of the pocket of not more than approximately 2" (51 mm). The operable wall shall open and close at an average speed of approximately 5 to 10 vertical feet per minute (1.5 to 3 meters per minute). When the operable wall is being lowered (closed), it shall stop if the leading (bottom) edge comes into firm contact with any object between it and the floor. The wall will then automatically reverse its direction and ascend for approximately 3 seconds to clear the object. The regular operation of the wall can resume once the obstruction has been removed.
- 2.1.9 Technical Requirements: The operable wall shall be visibly flat and rigid in the down (closed) position. There shall be no exposed hinges, brackets, screws, and no part of the mechanical system shall be visible when the operable wall is in the down (closed) position. All of the panel edges shall be right angled, with a minimum radius not more than 1/16" (1.6 mm). All of the panels shall be rectangular, nominally of the same size. Joints between panel, vertical and horizontal, shall be no more than approximately 1/2" (12.7 mm). Panels shall be individually removable without requiring special tools.
- 2.1.10 Acoustical Performance: The installed system shall conform with ASTM E90 (ISO 140-3), with an STC rating (Rw value) of not less than 51.
- 2.1.11 Durability: The operable wall shall be designed to have a design life of at least 10,000 complete opening cycles.
- 2.1.12 Installation: All work and materials specified herein, shall be installed only by qualified representatives and/or installers and/or distributors of the manufacturer, according to the manufacturers written instructions.

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- 2.1.13 **Warranty; Basic Warranty:** The operable wall shall be warranted free from defects in material and workmanship for a period of two (2) years or five thousand (5,000) cycles, whichever occurs first, from the date of shipment. **Extended Parts Warranty (optional):** An extended warranty on parts (excluding touch screen operator stations) is available in addition to the basic warranty. It includes coverage on all parts for a period of ten (10) years or five thousand (5,000) cycles, whichever occurs first from date of shipment. Refer to Owner's manual for full warranty details. **Acoustical Performance:** The operable wall shall retain its acoustical properties for 10 years from the date of shipment providing proper maintenance has been performed on the operable wall. Parts and labor required to maintain the operable wall and part subject to normal wear and tear are not covered under the warranty and are the owner's responsibility.
- 2.1.14 **Materials:** Acoustical panels shall be faced with steel that is compatible with a wide variety of architectural finishes. The finish and colour shall be selected by the Architect from the manufacturer's standard line.
- 2.1.15 **Panels:** Acoustical panels, together with all of the sound insulation, shall be, as much as possible, made of non-combustible or fire-treated materials. Acoustical panels shall be architecturally flat with no bowing, oil canning, warping, waviness or any other surface deformation and discontinuity.
- 2.1.16 **Folding Mechanism:** The hanging, folding and extension mechanism shall be made from structural grade aluminum extrusions and structural shapes, in order to minimize the weight of the system. All wear surfaces, such as bushings, spacers, pins, discs, bearings, and sleeves shall be designed to function quietly and with minimum wear, over the 10,000 cycle design life.
- 2.1.17 **Hangers & Supports:** Hangers, which fasten the lifting mechanism to the support steel, shall be fabricated from steel and shall be welded or bolted to the support steel supplied by others.
- 2.1.18 **Motor Drive:** The motor drive shall be sized properly so that it can open and close the wall effectively over the 10,000 cycle design life of the wall, at the minimum design speed specified.
- 2.1.19 **Safety Features:** The operable wall shall employ an electromagnetic type of brake which shall activate firmly, without hesitation, when power is lost to the system. This brake shall have a minimum retarding torque rating equal to 200% of the motor drive's full load torque. The drive system shall be equipped with a manual override and a brake release lever. Employ electrical or other limit switches in order to stop the wall at its up and down travel limits, and over torque detector in to sense a jam. The entire length of the bottom edge of the operable wall shall be equipped with a continuous pressure sensing strip which shall cut power to the motor drive and shall activate the brake if the sensing edge comes in firm contact with an object.
- 2.1.20 **Electrical:** Provide three phase power supply to the electrical control box (NEMA 1 or 4). Low voltage wiring shall be provided by the General Contractor, 18 gauge wiring from the switches to the control box. **Switches (standard, by Electrical):** Two (2) push button switches wired in series with power controlled by a single, three position key switch. One push button switch shall be equipped with an LED that flashes fault codes in case of an electrical system failure.

2.2 FABRICATION

- 2.2.1 Factory assemble all components, assemblies and systems into the largest possible assemblies in order to minimize the amount of assembly on site.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Shop assemble and deliver to the Site in the largest practicable sections.
The floor underneath the operable wall along its axis, shall be flat to within $\pm \frac{1}{4}$ " (6 mm) over the entire length of an operable wall. The peak to valley undulation of $\pm \frac{1}{4}$ " (6 mm) shall not be closer together than 24" (610 mm) and a peak to valley undulation of $\pm \frac{1}{8}$ " (3 mm) shall not be closer than 12" (305 mm).
- 3.1.2 Install the finished work free from distortion and defects detrimental to appearance and performance. Provide all components required for anchorage.
- 3.1.3 Support steel above the operable wall along its axis shall be parallel to the floor within $\pm \frac{1}{2}$ " (12.7 mm) for the entire length of the operable wall. This includes loaded deflection. The beam must also be parallel to the centre line of the wall within $\pm \frac{1}{8}$ " (3 mm), left to right. The fixed walls at either end of the operable wall shall be within $\pm \frac{1}{4}$ " (6 mm)-0", from plumb vertical.
- 3.1.4 The fixed walls at either end of the operable wall shall be flat to within ± 0 ", $\pm \frac{1}{4}$ " (6 mm).
- 3.1.5 Install operable walls in accordance with the manufacturer's printed instructions.
- 3.1.6 Ensure safe storage and protection for the operable wall for the duration of the project.
- 3.1.7 Spare Parts: Ensure the manufacturer has ample stock available for repairs. Provide any spare parts that may be used by the Owner for urgent on-site repairs or maintenance.

3.2 INSPECTION

- 3.2.1 Inspect the relevant aspects of the site such as the evenness of the floor, walls, structural steel, etc., and ensure that these are within the tolerances stated in Part – 1 of this specification.
- 3.2.2 Confirm in writing to the General Contractor or contract manager any deviations from these tolerances. Do not proceed until these conditions are made good.
- 3.2.3 Carry out all appropriate field measurements before manufacturing any components or assemblies.
- 3.2.4 Adjusting & Cleaning: Adjust and fine-tune the operable walls to ensure that all seals are operating and sealing properly and that the operable walls are in correct and smooth operation. Clean up any dirt, oil, grime, etc., that may have found its way onto the acoustical panels. Leave the wall in a state of architectural cleanliness

End of Section

Part 1 - General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Labour, Products, equipment and services necessary to complete the work of this Section, including but not limited to:
 - .1 Corner Guards (CG)
 - .2 Crash Rails (CRL)

1.2 RELATED REQUIREMENTS

- .1 Section 09 21 16 – Gypsum Board Assemblies
- .2 Section 09 22 16 – Non-Structural Metal Framing
- .3 Section 09 21 23 – Painting

1.3 REFERENCES

- .1 Green Seal Environmental Standards (GS): GS-36-11, Standard for Adhesives for Commercial Use.
- .2 Environmental Choice Program (ECP): CCD-046-95, Adhesives
- .3 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-04, Architectural Coatings.
 - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product Data:
 - .1 Prior to ordering products or materials, submit manufacturer's printed product datasheets for each type of product. Include product characteristics, performance criteria, physical size, finish and limitations for products listed in selected designs.
- .4 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
 - .1 Locations, extents and installation details of products.
 - .2 Obtain Consultants approval for number of panels, location of seams and fasteners prior to manufacture.
 - .3 Indicate details of proposed treatment where wall covering materials meets other materials.

- .5 Samples:
 - .1 Submit the following samples in accordance with Section 01 33 00
 - .1 One (1) Stainless Steel Corner Guard (1200 mm long)
 - .2 Two (2) 300 mm lengths of Crash Rail and associated end caps, Fastening cleats and accessories.
 - .7 Closeout Submittals:
 - .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions in accordance with Section 01 78 00 – Closeout Submittals.
 - .2 Submit warranties.

1.5 EXTRA MATERIALS

- .1 Provide extra materials.
- .2 At a minimum, provide the following:
 - .1 Corner Guards: Submit two (2) 1200 mm lengths of stainless-steel corner guards.
 - .2 Crash Rail: Submit (2) 2400 mm lengths of crash rail complete with fastening cleats and end caps.
- .3 Store in a location as directed by consultant.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufactures written instructions.

1.7 PROJECT CONDITIONS

- .1 Environmental Limitations: Do not commence work until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- .2 Materials must be acclimated in an environment of 18-24°C for at least 24 hours prior to beginning the installation. Relative humidity shall not exceed 75%.
- .3 Lighting: Do not commence work until a lighting level of not less than 160 lux is provided on the surfaces to receive wall covering.
- .4 Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall covering manufacturer for full drying or curing.

1.8 WARRANTIES

- .1 For all Work of this Section, PROVIDE a full three (3) year warranty.

Part 2 – Products

2.1 MATERIALS

- .1 Stainless Steel: Type 304, No. 4 brushed finish.
- .2 Aluminum: Extruded aluminum 6105-T5 alloy, nominal 0.62" thick. Minimum strength and durability properties as per ASTM B221; clear anodized finish to NAAMM recommendations.

- .3 Crash Rails (CRL): At locations and to extents as indicated on the Drawings:
 - .1 Basis of Design: Acrovyn/BCR-80
 - .1 Acceptable Alternate: Koroguard C760, by Koroseal
 - .2 Engineered plastic, high-impact, nominal .060" (1.52mm) thick sheet.
 - .3 Engineered rigid plastic, surface mounted, aluminum retainers with snap-on cover and integral continuous shock absorbing cushion.
 - .4 Fire Rating: Class A ASTM E-84.
 - .5 Colour: As selected by the Consultant from Manufactures Standard Range.
- .4 Corner Guards (CG): At locations and as indicated on the Drawings:
 - .1 Corner guards (90 degree) (45 degree) to extend to underside of Crash Rail. Where no crash rail is present corner guard shall extend 1200mm A.F.F unless noted otherwise.
 - .2 Basis of Design: Construction Specialties, ACO Series with 89 mm leg.
 - 1. Acceptable Alternate: Koroguard GS35, by Koroseal.
 - .3 16 gauge type 304 stainless-steel alloy with #4 satin finish in accordance with ASTM A276; surface mounted with manufacturer's recommended adhesive and tamper-resistant screws.
- .5 Immediately upon completion of installation, clean in accordance with manufacturers recommended cleaning method.
 - .1 Remove surplus materials, and debris upon completion or work.
 - .2 Protect installed materials to prevent damage by other trades.
- .6 Fasteners: tamper-resistant, noncorrosive and compatible with aluminum retainers supplied by manufacturer.
- .7 Adhesive: non-staining, water based and non-hazardous, for use with specific application, as recommended in writing by manufacturer.
- .8 Supply all brackets, primers and adhesive required to install items as per manufacturer's recommendations.

Part 3 - Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's printed installation instructions, standard and job-specific details, data sheets, and guide specifications.

3.2 EXAMINATION

- .1 Examine areas, which are to receive the work of this Section and proceed only if conditions are satisfactory. Verify adequacy of support at substrate. Report unsuitable substrates. Commencement of work shall imply acceptance of conditions.
- .2 Substrates shall be smooth, dry, free of dust and dirt.

3.3 PREPARATION

- .1 Remove materials from packaging and acclimatize materials in the installation areas not less than 24 hours before installation.
- .2 Test surfaces for moisture and alkali content prior to application of materials. Moisture content shall be less than 4%. Neutralize and seal surfaces in accordance with manufacturer's directions.
- .3 Comply with manufacturer's written instructions for surface preparation.
- .4 Clean substrates of substances that could impair wall covering's bond, including, oil, grease, incompatible primers, dirt, and dust.
- .5 Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
- .6 Remove hardware and hardware accessories, electrical plates and covers, and similar items.
- .7 Install Crash Rail and Corner Guards only once final paint coat has been applied.

3.4 INSTALLATION – CORNER GUARDS

- .1 Install work using construction adhesive, in accordance with manufacturer's written installation instructions and as shown on drawings.
- .2 Do not install corner guards until final paint coat has been applied.

3.5 INSTALLATION – CRASH RAILS

- .1 Install work using mounting hardware approved by the manufacturer, and locating all components firmly into position, level and plumb.
- .2 Do not snap crash rail into place until final coat of paint has been applied.
- .3 Adjust installed end caps as necessary to ensure tight seams.
- .4 Where splices occur in horizontal runs, splice retainer and rail at different locations along the run.

3.6 INSTALLATION TOLERANCES

- .1 Install straight and level to a tolerance of plus or minus 3 mm (1/8") over 3000 mm (10') straight edge, non-cumulative.

3.7 CLEANING AND PROTECTION

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Immediately upon completion of installation, clean wall covering and accessories in accordance with manufacturers recommended cleaning method.
- .3 Remove surplus materials, and debris upon completion of work.
- .4 Protect installed materials to prevent damage by other trades.

END OF SECTION

1 GENERAL

1.1 General Requirements

1.1.1 Conform to the Sections of Division 1 as applicable.

1.2 Description of Work

1.2.1 High Density Polyethylene bollard cover placed on bollard for protection, visibility and maintenance for exterior steel/concrete bollards.

1.2.2 Stainless Steel Bollard Cover placed over bollard located at Entrance.

1.3 Related Work Specified Elsewhere:

1.3.1 Section 05 50 00 –Miscellaneous Metals.

1.5 Submittals

1.5.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00- Submittals.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Bollard cover: High Density Polyethene, reflective striping, colour: yellow, size to fit bollard with 8" outside diameter and 48" height as indicated on drawings. Manufacturer to provide correct sizing to fit constructed bollard, Sureguard Polyethylene Bollard Shield or equal.

.1 Acceptable Manufacturer: Sureguard Security Products, Reliance Foundry or equal.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Install in accordance to Manufacturer's recommendations.

3.1.2 Set Stainless Steel Bollard into concrete footing as recommended by Manufacturer.

END OF SECTION

1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to Sections of Division 1 as applicable.

1.2 **RELATED WORK**

1.2.1 Concrete work by this Section in conformance with applicable requirements of Section 03 30 00, Cast-in-Place Concrete.

1.2.2 Flag(s) with their respective fittings for attaching to halyards: Supplied by others

1.3 **REFERENCES**

CSA A23.1-14	- Concrete Materials and Methods of Concrete Construction
CSA A23.2-14	- Methods of Test for Concrete
CSA A23.3-14	- Design of Concrete Structures for Buildings
CSA-G164-18	- Hot Dip Galvanizing of Irregularly Shaped Articles

1.4 **SYSTEM DESCRIPTION**

1.4.1 **Design Requirements:** Design flagpole, bases and anchorage devices to resist 100 km/h (60 mph) wind velocity minimum, flagged, or 165 km/h (100 mph) unflagged.

1.5 **SUBMITTALS**

1.5.1 **Shop Drawings**

1.5.1.1 Submit shop drawings in accordance with Section 01 33 00 Administrative Requirements.

1.5.1.2 Indicate materials, dimensions, finishes, base jointing, anchoring and support systems, cleats, halyard boxes, trucks, finials and base collar for flagpoles.

1.5.1.3 Provide templates and instructions for installation of flagpoles and bases.

1.5.2 **Samples:** Submit 2 - 50 mm x 100 mm (2" x 4") samples of flagpole finish.

1.6 **DELIVERY, STORAGE AND HANDLING**

1.6.1 Spiral wrap each flagpole with heavy kraft paper, wood strip and steel band or polyethylene wrap and pack in tubing for shipment.

1.6.2 Deliver flagpole in manufacturer's wrappings and in 1 piece.

2 PRODUCTS

2.1 GENERAL

2.1.1 Following manufacturers are acceptable provided they conform to requirements of this Specification. Manufacturers will be referred to hereinafter by their abbreviated names.

- John Ewing & Co. Inc. (John Ewing)
- All Canadian Flagpole Ltd. (All-Canadian).

2.2 MATERIALS

2.2.1 **Flagpoles:** 30'-0", Base Type 'B-5' Fixed, Econoline internal halyard system, Model #SCA30N or equal. Complete aluminum pole, including accessories, base and anchorage devices, by John Ewing or by All Canadian.

2.2.2 **Concrete Base:** CSA A23.1, CSA A23.2 and CSA A23.3; 20 MPa compressive strength after 28 days, maximum slump 100 mm (4"), air entraining 5% to 7%.

2.2.3 **Galvanized Steel:** To CAN/CSA-G164-M, minimum zinc coating of 0.610 kg/m² (2 oz/sq ft).

2.2.4 **Aluminum:** Aluminum Association alloy AA 6063-T6 seamless extruded aluminum tubing.

2.2.5 **Isolation Coating:** Alkali-resistant bituminous paint or epoxy resin solution.

2.3 ACCESSORIES

2.3.1 **Finial:** 100 mm (4") mm diameter ball of 1.6 mm (0.063") minimum thick aluminum anodized colour to match flagpole finish.

2.3.2 **Truck Assembly:** Cast aluminum, stainless steel ball bearing, nonfouling, revolving double truck assembly, (finish to match flagpole).

2.3.3 **Swivel Snaps:** 2 per halyard aluminum with neoprene or vinyl covers.

2.3.4 **Internal Halyard System:** Pole manufacturer's superior system; for poles minimum height 9 m (30') and minimum butt diameter 150 mm (6"); heavy duty

aircraft control cable; exposed parts to match flagpole finish.

2.3.4.1 Access Door: Keyed, removable flush mounted door in reinforced frame.

2.4 **FABRICATION**

2.4.1 Supply 9144 mm (30 feet) long flagpole as complete unit including base, mounting brackets, anchorage and fittings.

2.4.2 **Cone Tapered Flagpole**

2.4.2.1 Seamless, uniform, straight line tapered section above cylindrical butt section.

2.4.2.2 Taper: 25 mm (1") for every 1.7 m (5'-6") of run.

2.4.2.3 Provide internal splicing, self-aligning sleeve of same material as flagpole for snug fitting, watertight field joints.

2.4.3 **Pole Base:** Fixed, anchor type, flush base assembly, cast aluminum with galvanized steel template base and galvanized steel concrete anchors of minimum ultimate pull out strength of 88.96 kN (20,000 lbs). Base cover fabricated from aluminum alloy 6061, finish to match flagpole.

2.4.3.1 Fabricate ground-set foundation assembly for sleeve installation of flagpole as indicated.

2.4.3.2 Fabricate mountings of same metal as flagpoles where exposed and of galvanized steel where encased in concrete.

2.4.4 **Aluminum Finishes**

2.4.4.1 Finish: Brushed satin and waxed finish for cone tapered flagpoles. Chemically etched and clear anodized finish CE/AN/.0006/AP6 for swaged sectional flagpoles.

3 **EXECUTION**

3.1 **INSTALLATION**

3.1.1 Install flagpole on foundations where indicated on Drawings.

3.1.2 **Do concrete work as follows**

3.1.2.1 Of size and shape indicated on Drawings.

3.1.2.2 Top of base 150 mm (6") above finish ground level.

3.1.2.3 Anchor bolts for flagpole support to extend minimum of 900 mm (36") into concrete base.

-
- 3.1.2.4 Vertical exposed concrete placed into formwork and horizontal top provided with drainage channels or sloped to drain.
 - 3.1.2.5 Bring exposed surfaces to smooth steel trowel finish.
 - 3.1.3 Apply 1 coat of bituminous paint on steel surfaces in contact with concrete.
 - 3.1.4 Install pole, base assemblies and fittings in accordance with shop drawings and manufacturer's instructions. Use suitable equipment to prevent scuffing and damage to pole during erection.
 - 3.1.5 Erect pole plumb and true in position.
 - 3.1.6 Provide positive lightning ground for each flagpole installation.
 - 3.1.7 Check and adjust installed fittings for smooth operation of halyards.
 - 3.1.8 Install flag and demonstrate operation.
 - 3.2 **CLEANING**
 - 3.2.1 On completion of work, remove protection erected under this Section. Make good damage done to this work and adjoining work. Remove surplus materials, debris, tools, plant and equipment and leave Site in condition satisfactory to Consultant.

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED WORK

1.2.1 Installation of concrete base for sign pole including reinforcing, formwork and anchor bolts: Section 03 10 00; Section 03 20 00; Section 03 30 00 for concrete work.

1.2.2 Provision of Electrical supply including Electrical connection: Division 16, Electrical.

1.3 REFERENCES

CAN/CSA-G40.20-04/
CAN/CSAG40.21-04
Steels

General Requirements for Rolled or Welded
Structural Quality Steel/Structural Quality

SSPC

Steel Structures Painting Council, "Steel
Structures Painting Manual, Vol. 2"

1.4 DESIGN

1.4.1 Design signs to withstand wind loading equal to 1.676 kPa (35 lbs/sq ft) without failure of sign faces or connections to structure.

1.5 SUBMITTALS

1.5.1 Shop Drawings

1.5.1.1 Refer to Drawings for details of wall mounted and free standing signs.

1.5.1.2 Provide fully engineered shop drawings taking into consideration wind, soil conditions, concrete foundations and anchoring of sign post.

1.5.1.3 Submit shop drawings in accordance with Section 01 33 00 Submittals.

1.5.2 **Samples:** Submit samples showing finishes and colours of materials scheduled to be exposed in finished work and when requested, samples of workmanship showing letter typeface, joint quality and similar requirements.

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

1.6.1.1 Manufacturer of signs shall be specialist in this field having had previous experience in sign manufacturing and installation of type of signs specified.

1.6.1.2 Signs shall be of high strength polycarbonate. Manufacturers listed below are acceptable provided they are equivalent to and meet requirements of this

Specification.

Acceptable Manufacturers

Teksign Inc.

Steel Art Signs Ltd. Toronto, Ontario

Imperial Sign Corp. Toronto, Ontario

Excellent Signs and Displays Inc. London, Ontario.

2 **PRODUCTS**

2.1 **MATERIALS**

2.1.1 **Extruded Shapes:** Aluminum alloy Alcan 6063-T5 free from scratches and surface blemishes not less than 2 mm thick.

2.1.2 **Sheet:** Aluminum alloy 6063-T5 for exposed work requiring finish to match extruded sections. Concealed connectors, bracing and framework, aluminum alloy of Contractor's option but not less than 0.75 mm (22 ga) thick.

2.1.3 **Sign Poles:** 150 mm x 150 mm x 5 mm (6" x 6" x 5/16") Hollow Steel Section conforming to CAN/CSA-G40.20/CAN/CSA-G40.21, Grade 350W, to height indicated on Drawings. Pole shall be complete with welded base plate 300 mm x 250 mm x 19 mm (12" x 10" x 3/4") thick and drilled 4 holes for anchor bolts and 50 mm (2") diameter hole in centre of base plate for electrical conduit. Cover plate formed of 1.6 mm thick (16 ga) sheet steel or aluminum with welded corners.

2.1.4 **Finish**

2.1.4.1 Exposed Aluminum of Sign Box: Black anodized aluminum, Aluminum Association designation AA-C22A31 with minimum coating thickness of 0.0102 mm (0.4 mils).

2.1.4.2 Steel pole shall be surface prepared in accordance with SSPC SP3 and paint coated 1 coat Rust Inhibitive Alkyd primer at 75 um (3 mils) and 2 coats medium oil length Soya Alkyd resin finish coating at 50 um (2 mils) DFT/Coat. Total DFT 175 um (7 mils). Finish colour: Black.

2.1.5 **Sign Face:** High strength polycarbonate, 3 mm (1/8") thick, **sign face is not to be embossed.** Lettering and colours as indicated on Drawings. Sign face shall be spray painted with acrylic paint having suitable Ultra-Violet degradation inhibitors.

Acceptable Product

General Electric Canada Lexan

2.1.6 **Lighting**

2.1.6.1 Lamps: to be LED type.
Acceptable Manufacturers
Sylvania
Westinghouse
Canadian General Electric

2.1.7 Photocell Sensor: To be provided and installed. Co-ordinate with Electrical Division

2.1.8 **Fasteners:** Hardened aluminum or Series 300 stainless steel.

2.2 **FABRICATION**

2.2.1 **Sign Casing**

2.2.1.1 Make casing continuous without intermediate joints. Mitre corners to close tolerances, with attachments and fixing devices completely concealed.

2.2.1.2 Pole mounted sign boxes to be equipped with sign face both sides.

2.2.1.3 Wall mounted sign box to be capable of accepting standard OPP sign and separate Detachment sign in same box.

2.2.1.4 Internally reinforce case to maintain maximum horizontal and vertical deflection to 1/360 of clear span under OBC loading requirements. Ensure maximum water resistance of case. Provide back to wall mounted signs.

2.2.1.5 Design casing to ensure free thermal movement between dissimilar materials.

2.2.1.6 Space and overlap internal backlighting lamps to provide evenly distributed lighting intensity over entire face with no visible trace of tube shadowing. Provide internal aluminum reflectors.

2.2.1.7 Completely prewire sign internally and provide at 1 end of sign, junction box or terminal box complete disconnect switch and with terminals for connection of power wiring supply.

2.2.1.8 Provide hand hole in pole not more than 300 mm (12") above base for electrical connection and provide 1 water tight Duplex outlet mounted on face of pole and complete with Ground Fault Interrupter (GFI).

2.2.2 **Sign Facing**

2.2.2.1 Make facing in 1 piece to pole mounted signs and as indicated and specified on Drawings.

2.2.2.2 Make facing to wall mounted signs in 2 pieces with Detachment name as separate face.

2.2.2.3 Face plate shall be removable for service access.

2.2.2.4 Graphics shall be spray painted.

2.2.3 **Sign Back:** 0.80 mm coated sheet metal.

2.2.4 **Fastenings**

2.2.4.1 Exposed metal fastenings and accessories shall be of same colour and finish as

base metal on which they occur.

- 2.2.4.2 Metal fastenings shall be of stainless steel or same material as metal component they are anchoring or of a metal which will not set up an electrolytic action to the fastening or metal component under moist conditions.

- 2.3** Sign Installer to provide fully engineered approved shop drawings taking into consideration wind, soil conditions, concrete foundations and anchoring of sign post.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Build and erect signs plumb, true, square, straight, level and accurate to sizes detailed on reviewed shop drawings, free from distortion or defects detrimental to appearance and performance.
- 3.1.2 Install wall mounted sign(s) in the locations indicated on Drawings. Bolt through sign framing to brick work or other structure using lag bolts with lead sleeves.
- 3.1.3 Install pole mounted sign on prepared foundation using stainless steel anchor bolts, washers and shims. Pole shall be plumb and sign box shall be mounted with face plane on same axis as pole. Install cover plate over anchor bolts.
- 3.1.4 Upon completion of signs, clean all exposed surfaces.

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.1.1 Refer to drawings for correct quantity of Abloy Locks to be supplied and installed under this Section.

1.1.2 Refer to drawings for correct quantity of Padlocks to be supplied under this Section for Locker Room Lockers.

1.2 RELATED SECTIONS

1.2.1 Wood furring for locker attachment: Section 06 10 00, Rough Carpentry.

1.3 SUBMITTALS

1.3.1 Shop Drawings

1.3.2 Submit shop drawings in accordance with Section 01 33 00 Submittals.

1.3.3 Verify dimensions on the Site before preparing drawings or proceeding with shop work.

1.3.4 Include details of lockers, trim, end panels, gauges of materials, methods of installation and fastening.

1.3.5 Job check dimensions where work is installed against finished surfaces.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Following manufacturers and locker types are acceptable provided that they conform to every other requirement of these Specifications:

Acceptable Manufacturers

GSS;

Lincora;

Or approved equal.

2.1.2 Consultant will not accept changes to manufacturer's products without prior notification in sufficient time to evaluate effects of such changes prior to tender closing date.

2.1.3 Where a manufacturer's standard product line does not fully meet specified requirements in every characteristic it is intended that manufacturer will upgrade his product to required standard to qualify as a supplier or will refrain from bidding.

2.2 **FABRICATION**

2.2.1 Fabricate lockers to following dimensions or to sizes and to profiles shown on the Drawings from the following materials and thicknesses (gauges):

2.2.2 Lockers **L1**: shall be Divided Double Wide Lockers, 610mm wide x 457 mm deep (24"x18") x 1829 mm (72"), vented with punched door and sides.

.1 Door, Frames and Locker Bodies:

1 **Doors** shall be made with the **16 gauge** outer door panel formed with channels on both sides and the top and bottom. The 22 gauge full width inner door panel shall **cover over the back of the pocket to eliminate vandalism**, be formed with channels on both sides, interlocked with the outer panel, and mig welded together at the top, bottom and both sides on the back surface edges of the door. The box welded door assembly shall be 1-1/8" thick. Single pan outer doors with partial inner door reinforcing pans are not acceptable. The door shall close on the 16 gauge frame member with a 5/8" wide closure strike the full height of the door and shall fit flush with the outside of the frame. The door shall be hung on a **16 gauge continuous one-piece integral right hand Hinge and Frame**. Every other knuckle of the hinge shall be staked to the .125" diameter steel hinge pin so the pin cannot be removed.

2 Frames shall be welded together from specially formed channel sections of prime cold rolled steel. Provide two rubber door grommets on the lock side of the frame. Ventilated slots shall be incorporated into the top and bottom frame members.

3 Bodies: Locker sides shall be fabricated from 16 gauge cold rolled steel. Locker backs shall be fabricated from 16 gauge cold rolled steel with right angle flanges on the vertical side. Tops, bottoms and shelves shall be formed from 16 gauge cold rolled steel flanged on all four sides with a formed under return at the front of the shelves.

.2 **Trims, Fillers, End Panels, Bases**: All Trims, fillers, End Panels and Bases will be manufactured from **16 gauge cold rolled steel**. Provide finished end panels where required as indicated on drawings Review drawings for location of filler panels at corners and where lockers terminate at walls. Exact dimensions of the filler panels shall be determined from actual site measurements and approved during the shop drawing review.

- .3 **Number Plates:** Provide number plates for all locker types. Rivet onto pull or on door body and numbered in order as noted on shop drawings.
- .5 **Finish:** All cold rolled steel surfaces shall be pretreated with an iron phosphate corrosion inhibitor and finished with an abrasion and graffiti resistant **Polymer Powder Coating** cured to ensure a tough and durable finish. All surfaces shall meet or exceed a salt spray resistance of 300 hrs with a maximum of 1/8" creepage from scribe according to ASTM B117. Color shall be selected from the Manufacturer's standard color chart.

2.3 Equip each Divided Double Wide Locker with:

- 2.3.1 Recessed base.
- 2.3.2 Sloped Top.
- 2.3.3 Two non-removable rubber bumpers placed 200 mm (8") from the top and bottom of the door on the lock side.
- 2.3.4 Coat Rod underneath locker shelf with secure full extension valuables drawer with keyed lock.
- 2.3.5 Three single wall hooks.
- 2.3.6 Numbered number plates complete with numbers in order shown on shop drawings.

2.4 Equip each Standard Locker with:

- 2.4.1 Recessed base.
- 2.4.2 Two non-removable rubber bumpers placed 200 mm (8") from the top and bottom of the door on the lock side.
- 2.4.3 Coat Rod underneath locker shelf.
- 2.4.4 Three single wall hooks.
- 2.4.5 Numbered number plates complete with numbers in order shown on shop drawings.

2.5 Ventilation: Provide proven, unobstructed free-flow ventilation at top and bottom of lockers.

2.6 Locking System: Single Point Latching: single point latching shall be through an 20 gauge single piece deep-drawn stainless steel recessed pocket. The single piece 12 gauge channel formed hasp shall be welded to both legs of the 16 gauge channel frame member. Rivetted hasps are not acceptable.

2.6.1 Padlock Combination Lock: Provide one (1) padlock combination lock for each locker located in Room 126, 130, and 162. Locks shall be: Combination Lock 78KC/50 with master key function, as Manufactured by: Abus. Supplied by this Section.

2.7 **Finish:** Lockers and trim shall be finished in baked enamel of colours selected by Consultant from manufacturer's standard colour range. Frames shall be one colour, doors, trim and tops shall be in a range of three at no extra cost.

2.7.1 Provide dress end panels at both ends of each locker bank, false locker fronts, blank fillers and trim as required.

2.7.2 No manufacturer's names are allowed on the front of the lockers.

2.8 **Double Tier Lockers L2:.**

.1 Door, Frames and Locker Bodies:

1 **Doors** shall be made with the **16 gauge** outer door panel formed with channels on both sides and the top and bottom. The 22 gauge full width inner door panel shall **cover over the back of the pocket to eliminate vandalism**, be formed with channels on both sides, interlocked with the outer panel, and mig welded together at the top, bottom and both sides on the back surface edges of the door. The box welded door assembly shall be 1-1/8" thick. Single pan outer doors with partial inner door reinforcing pans are not acceptable. The door shall close on the 16 gauge frame member with a 5/8" wide closure strike the full height of the door and shall fit flush with the outside of the frame. The door shall be hung on a **16 gauge continuous one-piece integral right hand Hinge and Frame**. Every other knuckle of the hinge shall be staked to the .125" diameter steel hinge pin so the pin cannot be removed.

2 Frames shall be welded together from specially formed channel sections of prime cold rolled steel. Provide two rubber door grommets on the lock side of the frame. Ventilated slots shall be incorporated into the top and bottom frame members.

3 Bodies: Locker sides shall be fabricated from 16 gauge cold rolled steel. Locker backs shall be fabricated from 16 gauge cold rolled steel with right angle flanges on the vertical side. Tops, bottoms and shelves shall be formed from 16 gauge cold rolled steel flanged on all four sides with a formed under return at the front of the shelves.

.2 **Trims, Fillers, Slope Tops, End Panels, Bases:** All Trims, fillers, Sloping Tops, End Panels and Bases will be manufactured from **16 gauge cold rolled steel**.

.3 **Number Plates:** Provide number plates for all locker types. Rivet onto pull or on door body and numbered in order as noted on shop drawings.

.4 **Shelf Locations at Double Tier Locker:** The double tier locker shall have a shelf located approximately halfway in the interior of the locker.

- .5 Finish: All cold rolled steel surfaces shall be pretreated with an iron phosphate corrosion inhibitor and finished with an abrasion and graffiti resistant **Polymer Powder Coating** cured to ensure a tough and durable finish. All surfaces shall meet or exceed a salt spray resistance of 300 hrs with a maximum of 1/8" creepage from scribe according to ASTM B117. Color shall be selected from the Manufacturer's standard color chart.
- .6 **Locking System Lockers:** Prepare pocket for master cylinder (Abloy Lock) to be supplied and installed under this Section. Install lock in stainless steel recessed pocket for double and four tier lockers. 6 tier lockerettes shall be constructed without a pocket. Prepare door for lug plate lock reinforcement and install Abloy Lock.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Shop assemble and deliver to the Site in the largest practicable sections.
- 3.1.2 Install lockers in locations shown on the Drawings. Install the work true to dimensions, square, plumb and level. Accurately secure joints and intersecting members with adequate fastening, plumb, rigidly attached both to each other and to building structure.
- 3.1.3 Install the finished work free from distortion and defects detrimental to appearance and performance. Provide all components required for anchorage.
- 3.1.4 Install filler panels and trims as required to close openings between lockers and surrounding or adjacent surfaces.
- 3.1.5 Securely fasten lockers to wood grounds and nailing strips. Lockers shall be securely fastened to wall and floor every second locker.
- 3.1.6 Install jamb trim at ends where lockers and masonry wall abut.

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.1.2 Refer to drawings for correct quantity of Abloy Locks.

1.2 SUBMITTALS

1.2.1 Shop Drawings

1.2.2 Submit Shop Drawings in accordance with Section 01 33 00 Submittals.

1.2.3 Shop Drawings shall indicate and describe in detail the work of this Section including large scale detail of members and materials, and of anchorage devices, dimensions, gauges, thickness, as well as other pertinent data and information.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire mesh partitions manufactures or equal.
Acceptable Manufacturers
Morningstar Industries. Ltd.
Redirack Industries Ltd.

2.1.2 **Wire Mesh Panels:** 4.88 mm diameter (6 ga.) (.192") steel wire electrically welded to form 51 mm x 51 mm (2" x 2") mesh. Spot weld mesh at 101 mm (4") o.c. to a 32 mm x 32 mm x 3 mm (1-1/4" x 1-1/4" x 1/8") minimum steel angle frame.

2.1.3 **Posts:** Minimum 1.897 mm thick (14 ga.), 50 mm x 50 mm (2" x 2") steel tubing complete with 65 mm x 175 mm x 6.4 mm (2-1/2" x 7" x 1/4") base plates welded to post bottom and drilled to receive fasteners.

2.1.4 **Doors:** single door width as indicated on drawings; Door Opening Height - 2216 mm (87-1/4 inches), with transom of similar construction to full height of partition Manufacturer's standard with transom panel, suitable framing to receive hardware and hinges; Hinges: 3 5-knuckle tight-pin butt hinges fastened to door panel and frame.

2.1.5 **Finish:** Factory finished with base coat of rust inhibiting primer followed by manufacturer's standard baked enamel finish selected by Consultant from manufacturer's standard colour range.

2.1.6 **Padlock and Padlock Hasp:** PL330/25 Padlock and PL204, non-handed locking plate with 12mm shackle hole as manufactured by Abloy. Padlock supplied by Municipal Police. Padlock Hasp to be supplied and installed under this Section.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install wire mesh partitions in locations indicated on Drawings, plumb, level, straight and secured to building structure.
- 3.1.2 Provide additional bracing and reinforcing as required to suit partition heights.
- 3.1.3 Provide 76 mm (3") sweeping clearance.
- 3.1.4 Provide clips, bolts and other ancillaries required to complete the installation.
- 3.1.5 Touch-up damaged areas during transportation and installation.
- 3.1.6 Install finish hardware including locking system supplied by this Section.

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2	<u>Storage shelving to be anchored to perimeter walls where located along walls.</u>

1.3 SUBMITTALS

1.3.1 Shop Drawings

1.3.1.1 Submit shop drawings in accordance with Section 01 33 00 Submittals..

1.3.1.2 Show all materials fabrication, manufacturer's data sheets in accordance Section 01 33 00 Submittals.

2 PRODUCTS

2.1 MATERIALS

2.1.1 **Shelving:** Products by the following manufacturers are acceptable.
Acceptable Manufacturers
Rousseau or equal,
SpaceSaver,
Global Industries,
Southwest Solutions.

2.1.2 **Open Rack Shelving SH1, 2, 3:** Standard parts consisting of 4 uprights per unit to which shelves are bolted or clip fastened. Provide side sway braces on the two exposed sides of each rack or bank and at alternate sections throughout the length of the bank. Provide back sway braces on the two end sections of each bank and on alternate sections.

2.1.3 **High Density Shelving – Rooms 114, 211:** High density full-height shelving system with fixed end units and manually moveable intermediate units as shown on the Drawings, complete with adjustable shelves.

2.1.4 **Shelves:** Minimum .91 mm (20 ga.) steel up to 460 mm x 900 mm (18" x 36") and minimum 1.21 mm (18 ga.) over that size. 3,000 lb. Shelf Cap. Shelves shall have formed flanges on 4 sides.

2.1.5 **Uprights:** 25 mm x 50 mm (1" x 2") formed steel angle, minimum 1.90 mm (14 ga.), punched at maximum 50 mm (2") intervals throughout the entire length. Uprights to be 2440 mm (96") high.

2.1.6 **Kickplate:** Minimum 1.21 mm (18 ga.) steel to close space between bottom shelf and floor at front and at exposed ends.

2.1.7 **Finish:** Manufacturer's standard finish selected by Consultant.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install units neatly aligned, plumb and level. Bolt adjacent units together to form an assembly. **Securely anchor to walls where located along perimeter walls.**

End of Section

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 Hand Dryers shall be included in the Base Bid, Refer to Electrical Specification to be installed by Electrical Contractor.

1.3 RELATED SECTIONS

1.3.1 Rough-in for recessed or built-in fixtures: Section 04 20 00, Masonry or Section 09 29 00, Gypsum Board.

1.3.2 Stainless Steel toilet partitions: Section 10 21 00, Stainless Steel Toilet Partitions.

1.3.3 Power supply and electrical wiring to hand dryer: Division 26, Electrical.

1.4 REFERENCES

ASTM A167-99	Standard specification for Stainless Heat Resisting Chromium Nickel steel Plate, Sheet and strips.
ASTM A653/A653M-01a	Standard Specification For Steel Sheet Zinc-Coated (Galvanized) or Zinc-Alloy Coated (Galvanealed) by the Hot-Dip Process
ASTM A924/A924M-99	Standard Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
CAN/CGSB 12.5M86	Mirror, Silvered
CAN/CSA B651-95	Barrier Free Design
CAN/CSA G164 M92	Hot Dip Galvanizing of Irregularly Standard Articles.

1.5 SHOP DRAWINGS

1.5.1 Submit shop drawings or manufacturers' data sheets bound in sets in accordance with Section 01 33 00 Submittals.

1.5.2 Submit necessary templates and instructions where recesses, openings, details for fastening devices or anchors to be built in by other Sections.

1.5.3 Submit complete list of washroom accessories proposed giving manufacturer's name and catalogue number for each.

1.6 **SAMPLES**

- 1.6.1 Submit manufacturer's cut sheets of washroom accessories, finishes and fastening devices for approval by Consultant before ordering.
- 1.6.2 Provide manufacturer's service and parts manual for incorporation into the Building Maintenance Manual.

1.7 **DELIVERY, STORAGE AND HANDLING**

- 1.7.1 Deliver accessories wrapped in original packages with manufacturer's labels, and seals intact.
- 1.7.2 Store accessories inside building in location directed and in well identified package as to contents.

2 **PRODUCTS**

2.1 **General**

- 2.1.1 Following abbreviations of manufacturer's or supplier's company names apply.

Abbreviations	Full Name of Company
Frost	Frost Products Ltd.
Bobrick	Bobrick Washroom Equipment Inc.
ASI Group	ASI Group Canada

- 2.1.2 Listed products are equally acceptable. Unless chosen manufacturer can not provide required product, products of single manufacturer shall be used.
- 2.1.3 **Sheet Steel:** to ASTM A653/A653M with ZF001 designation steel coating.
- 2.1.4 **Stainless Steel** sheet metal: to ASTM A 167, Type 304, with satin finish.
- 2.1.5 **Stainless Steel** Tubing: Type 304, seamless welded, 18 gauge (1.2mm) wall thickness.
- 2.1.6 **Fasteners:** Concealed screws, and bolts, hot dip galvanized, where exposed to match face of unit. Expansion shields fibre, or rubber as recommended by accessory manufacturer for intended use.

2.2 **MANUFACTURED UNITS**

- 2.2.1 **Single Jumbo Roll Toilet Tissue Dispenser:** surface mounted, satin-finish stainless steel. Equipped with lock keyed like other washroom accessories. Spindles hold single 10" (255mm) diameter rolls with 2 1/4" (55mm) diameter

core roll; convertible for 3" (75mm) diameter core rolls. Rubber o-rings (2) furnished by manufacturer may be added to accommodate a 2-1/8" (55 mm) diameter core roll. Stainless Steel mounting plate. Viewing slot reveals tissue supply. Unit 10 21/32" W, 10 5/8" H, 4 1/2" D (270 x 270 x 115mm). Provide one (1) at each water closet location.

Acceptable Products

Bobrick	B-2890 T
ASI Group	0046

- 2.2.2 **Combination Paper Towel Dispenser And Waste Receptacle:**, semi-recessed type, one piece coverall door, min 0.792 mm (22 ga) thick stainless steel, satin finish, dispenses multi fold, single fold or roll towels, self-closing waste door, door with concealed full length hinge and with 2 point locking device, removable leakproof plastic waste receptacles. One (1) in each washroom location

Acceptable Products

Semi-Recessed

Frost	400-14A
Bobrick	B-380382
ASI Group	64676-4

- 2.2.3 **Recessed Sanitary Napkin Disposal Bin** recessed, 90 degree pull door type with continuous piano hinge, min 0.792 mm (22 ga) thick stainless steel, satin finish, with embossed International graphic symbols. Provide one (1) at UN. WR.

Acceptable Products

Bobrick	B-353 CAN
ASI Group	0473

- 2.2.4 **Surface Mounted Sanitary Napkin Disposal Bin** – surface mounted unit with removable waste bin. Door secures to cabinet with magnet catch and cable door-swing limiter. Waste receptacle has a capacity of 0.6-gal (2.3-L) Skirt is removable in the field for optional recessed mounting. 90 degree pull door type with continuous piano hinge, min 0.792 mm (22 ga) thick stainless steel, satin finish, with embossed International graphic symbols, complete with leak proof plastic waste receptacle. Provide 1 at each Female water closet and 1 at Univ. WR.

Acceptable Products

Bobrick	B-35139 US
Or equal	

- 2.2.5 **Grab Bars And Safety Rails:** 38 mm (1-1/2") o.d. stainless steel satin finish with peened grip surface, min 1.270 mm (12 ga) wall thickness, complete with flanges, exposed mounting, shapes and lengths indicated on schedule, four locations, two in each barrier free toilet compartment and where indicated.

Acceptable Products

Exposed Mounting

Bobrick	B-6806 US
Watrous	W-3500 P

- 2.2.6 **Shower Curtain Rod:** 25.4 mm (1") od stainless steel, satin finish, min 0.952 mm (20 ga) wall thickness, complete with curtain hooks and flanges, 1524 mm(60") wide:
Acceptable Products
Bobrick B-207 – provide 12 hooks US
ASI Group 1214-1 &1214-2
- 2.2.7 **Shower curtain & Curtain hooks:** min 4.762 mm (7 ga) thick, opaque, weighted waterproof, mildew resistant, non combustible vinyl, 12 rustproof nickel or chrome plated grommets to accommodate shower rings, 1829 mm (72") wide x 1778 mm (70") high. Provide 12 hooks. White vinyl:
Acceptable Products
Bobrick B-204-3 US
ASI Group 1200-V72/1200-SHU
- 2.2.8 **Soap Basket:** soap basket has open spaces between wires to allow excess water to drain away from soap and promote drying. Satin-finish stainless steel on all visible surfaces. Stainless steel setscrew provided on bottom perimeter of flanges to lock unit to mounting plates, one in each shower cubicle:
Acceptable Products

ASI Group 7322
Or equal.
- 2.2.9 **Double Robe Hook:** surface mounted, type 304 stainless steel, satin finish with flange equipped with concealed min 1.6 mm (16 ga) mounting bracket which locks to conceal min 1.6 mm (16 ga) stainless steel wall mounting bracket welded to support arm. One (1) at each barrier free washroom or stall, 1 at each shower.
Acceptable Products

Double Robe Hook
Bobrick B-7672 T
ASI Group 7345
- 2.2.10 **Stainless Steel Shelf:** stainless steel type 304 No. 4 brushed finish, 125 mm (5") d x 460 mm (18") w x 100 mm (4") h; rounded corner shelf with safety edges on all protruding sides, 22 ga. Stainless steel no. 4 brushed finish welded to stainless steel wall plate.

Acceptable Product:
Bobrick B-295 x 18 US
ASI Group 0692-518
- 2.2.11 **Mop Or Broom Holder:** min 610 mm (24") long surface mounted stainless steel base, min 0.792 mm (22 ga), with 3 spring loaded, rubber cam holders for mops or brooms:
Acceptable Products
Bobrick B-223x24 (24") T
ASI Group 8215-3 (26")

- 2.2.12 **Janitor's Utility Shelf With Mop Holders and Rag Hook:** 205 mm x 760 mm 8"x 30"long, surface mounted, type 304 satin finish stainless steel shelf, min 1.270 mm (18 ga), mop/broom holders - 3 spring loaded rubber cams with anti slip coating, 2 stainless steel rag hooks, shelf 18ga with 38mm (1 ½") return edge, with stainless steel rod:
Acceptable Products
Frost 1115
Bobrick B-224x30 T
ASI Group 1315-3
- 2.2.13 **Solid Phenolic Folding Shower Seat:** frame constructed of type-304, satin finish stainless steel, 1.6 mm (16-ga.), 32 mm (1-1/4") square tubing and 1.2 mm (18 ga), 102 mm (1") diameter seamless tubing, Rectangular seat constructed of one-piece 8 mm (5/16") thick, water resistant white solid phenolic with black edge:
Acceptable Products
Bobrick B-5191 US
ASI Group 8203
- 2.2.14 **Hand Dryer:** Refer to Electrical Specifications
- 2.2.15 **Automatic Wall Mounted Soap Dispenser:** Wall surface mounted, container body and back, type 304 stainless steel, satin finish, 900 ml (30 oz) capacity vandal resistant mounting, concealed locking device, hinged filler top and polycarbonate refill window, powered by battery.

Acceptable Products
Bobrick B-2012 T
ASI Group 0362
- Automatic Vanity Mounted Soap Dispenser:** Vanity Mounted Stainless Steel Automatic Liquid Soap Dispenser shall hold and dispense soaps with a viscosity range of between 5 and 3000 mPa·s or cP (MilliPascal-sec or Centipoise) from supply tank in pump housing with a capacity of 1500 ml (50.7 oz). Dispenser spout body shall be type 304 stainless steel alloy 18-8 and all exposed stainless steel surfaces shall be satin finish, 4" (100 mm) spout length, 1" to 1-1/2" (25 mm) mounting thickness. Provide multi AC adapter to connect all soap dispensers below each vanity.
detergents:
Acceptable Products
Bobrick B-8263 T
ASI Group 0334S
- 2.2.16 **Baby Change Table:** Constructed of polypropylene and a unibody steel chassis, supports 200 lbs., steel-on-steel hinge with gas spring mechanism for smooth open and close of the unit. The dual liner cavity with lock minimizes operator refills and discourages potential vandalism. The product includes child protection straps and bag hooks. Bed surface contains Microban® antimicrobial, reducing odor causing bacteria. Liner dispenser features two liner cavities. Each cavity holds 25 liners, for a combined total of 50 liners per unit. Unit Dimensions: 893 mm x 565 mm (35-3/16" w x 22-1/4" H); Depth(closed): 102 mm (4"), Extension (open) 589 mm (23-3/16")

Acceptable Products
Koala Care KB 200 or equal. US

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install washroom accessories securely level and plumb with concealed fastener supplied by accessory manufacturer and in accordance with their recommendations, and to satisfaction of Consultant.
- 3.1.2 For recessed installations in masonry or gypsum board, coordinate with 04 20 00 Masonry and/or 09 29 00, Gypsum Board and supply units dimensions and clearances requirements to other trades to permit proper settings.
- 3.1.3 Install accessories in locations and at heights indicated on Drawings in accordance with all applicable codes and standards. Where not indicated, install as directed by Consultant.
- 3.1.4 Insulate accessory surfaces to prevent electrolysis due to contact with masonry, concrete or dissimilar metal surfaces by approved means.
- 3.1.5 Power supply to automatic soap dispenser and wiring shall be provided by Division 16, Electrical. Make connections at soap dispenser and at control panel and supply and install all electrical work required and as directed by manufacturer of unit. Comply with requirements of Division 16, Electrical. All wiring shall be concealed.
- 3.1.6 Upon completion of Work, or when directed, remove all traces of protective paper or coatings. Test mechanisms, hinges, locks and latches and adjust and lubricate where necessary to leave in perfect order. Make good all damage to satisfaction of Consultant.

End of Section

Part 1 – General

1.1 REFERENCES

- .1 National Electrical Manufacturers Association (NEMA): NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- .2 Underwriters Laboratories (UL): UL 325 - Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- .3 Underwriters Laboratories (UL): UL 991 - Standard for Tests for Safety-Related Controls Employing Solid-State Devices.
- .4 CSA C22.2 No. 247-2019, Operators and systems of doors, gates, draperies, and louvres

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 traffic signage, including product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate items as follows:
 - .1 Sign message, dimensions, materials, erection details and methods of attachment for each sign.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Store products indoors in manufacturer's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.

1.4 WARRANTY

- .1 Manufacturer's Standard Limited Warranty:
 - .1 Warranty Period:
 - .1 Two (2) years for all products,
 - .2 Ten (10) years for operator frame.

1.5 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: ISO 9001 Certified Manufacturer.

Part 2 – Products

2.1 ACCESS CARD READER AND VIDEO INTERCOM STAND

- .1 Equal to Pedestal Pro 64" Dual Height Gooseneck Pedestal – Single Channel. Set into 18" dia. X 1800mm deep concrete sonotube.
- .2 Provide Pedestal Pro 8x8 Steel Housing – Single Gang Cutout. Keypad by others.
- .3 Provide 25mm dia. Conduit underground to gate controller.

2.2 VEHICLE DETECTION LOOP

- .1 Pre-formed vehicle detection loop in 21mm RPVC
- .2 Conductors: stranded for 14 AWG and larger.

2.3 BOLLARDS

- .1 150mm Standard steel pipe filled with concrete and painted yellow. Refer to typical bollard detail on Structural drawings.

2.4 SLIDING GATE OPERATOR

- .1 Gate Operators: SL595UL Industrial Gear-Driven Slide Gate Operator or equal.
 - .1 Compliance: UL Listed. UL 325, UL 991 and CSA C22.2 No. 247 standards.
 - .1 Intended for use in Class I, II, III and IV vehicular slide gate applications.
 - .2 Monitored Safety Inputs: 3 inputs per board (main board and expansion board) totaling 6 inputs with any combination of up to:
 - .3 Main Board:
 - .1 One (1) Monitored Close Photo Eye input.
 - .2 One (1) Monitored Open Photo Eye input.
 - .3 One (1) Monitored Open Safety Edge or Open Photo Eye input.
 - .4 Expansion Board:
 - .1 Two (2) Monitored Safety Edge or Photo Eye inputs (selectable for Open or Close).
 - .2 One (1) Monitored Photo Eye input (selectable for Open or Close).
 - .3 Eight (8) Monitored edges available when (Model LMWEKITU) is added.
 - .5 Warranty: two (2) years.
 - .6 Operator Speed: 12 inches (305 mm) per second.
 - .7 Electrical Power Requirements:
 - .1 120V AC, single phase, 60 Hz.
 - .8 Accessory Electrical Power Requirements: 24V AC.
 - .1 Main Board: 12V AC, maximum 500mA.
 - .2 Terminal Strip: 2.2A maximum for 115/208-230V AC, single phase.
 - .9 Gear Reduction: 20:1 wormgear reducer in synthetic oil bath.
 - .10 Motor: Switchless 1-1/2 HP, continuous duty.
 - .1 Capacity: Supports gate lengths up to 80 feet (24.4 m) and gate weights up to 2,100 pounds (953 kg).
 - .11 Metal Frame: 7-gauge pre-galvanized steel.
 - .12 Chassis: Powder-coated galvanized steel.
 - .13 Enclosure: NEMA 3R enclosure; oil-tight, weatherproof NEMA 3R cabinet, lockable.

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- .14 Chain: #50 nickel-plated, 25 feet (7620 mm) supplied with each unit.
 - .15 Gearbox: All-weather.
 - .1 902 to 928 MHz
 - .2 50-channel FHSS (Frequency Hopping Spread Spectrum).
 - .3 828LM Internet Gateway enables monitoring and control of gate operators via internet-enabled smartphone, tablet or computer
 - .16 Receiver: Security+ 2.0 3-channel on-board radio receiver, holds up to 50 remote controls (unlimited with use of 811LM/813LM), HomeLink compatible
 - .17 Transmits 310 MHz, 315MHz, 390 MHz
 - .18 Inherent Reversing Sensor: Utilizes Current Sense and RPM Sensor to detect obstructions or increased loads. Reverses gate when closing or stops/reverses the gate when opening.
 - .19 Lockout/Tagout: Prevents power from being switched on when servicing operator. Safeguards workers from high voltage power.
 - .20 Programmable Auxiliary Relays: 2 programmable relays with 6 settings each.
 - .1 Pre-warning or gate-in motion sounder
 - .2 Switch on/off devices at open or Close Limits or while gate is in motion.
 - .3 Tamper detection if gate is pushed off Close Limit
 - .4 Cycle quantity feedback.
 - .5 Red/Green Light to control gate traffic.
 - .21 Quick Close, Anti-Tailgate: Secures property, preventing unauthorized access.
 - .22 Sequenced Access Management: Capable of sequentially controlling the operator in tandem with a barrier gate.
 - .23 Plug-in Loop Detector Inputs: Programmed inputs for shadow, interrupt and exit.
 - .24 Maximum Run Timer: Protects against damage to the gate and operator by limiting the unit's run time to 120 seconds.
 - .25 Lockable External Manual Disconnect: Allows gate to be opened in the event of a power loss without removing the operator cover.
 - .26 Mechanical Braking: the mechanical braking system adds substantial gate position control at all points in travel. The solenoid-actuated brake system also prevents the gate from being back-driven
 - .27 Friction Clutch: Adjustable friction clutch helps protect gate and operator from damage should the gate meet an obstruction.
 - .28 Limit Settings: Driven limit nut switches are fully adjustable to provide precision, accuracy and reliability.
 - .29 Operating Temperature Range:
 - .1 With Optional Heater: -40 to 140 degrees F (-40 to 140 60 degrees C)
 - .2 Monitored Photo Eyes: Monitored Through-Beam Photo Eyes
 - .1 Photo eye emitter, photo eye receiver each with 6 ft (1829 mm) cable, 2X photo eye bracket, 2X photo eye hood, mounting hardware.
 - .2 Compliance: UL 325 requirements for gates as secondary entrapment protection.
 - .3 Enclosure: NEMA 4X waterproof and corrosion-resistant enclosure.
 - .4 Installation Design: Dual-sided, if used in dual gate applications. Operator wireless communication can be used to avoid trenching.
 - .5 Alignment: LED indicator with visible feedback and adjustable photo eye.
 - .6 Photo Eye Beam: Polarized beam technology sends and receives beam through 2 polarized filters to avoid interference from shiny objects.

- .7 Sensing Distance: 90 feet (27 m).
- .8 Operating Temperature Range: -40 to 149 degrees F (-40 to 65 degrees C).
- .9 Power: 2-wire photo eye interface.
- .10 Operating Current: Greater than or equal to 40 mA.
- .11 Output Versions: Monitored 2-wire.
- .12 Response time: 35 milliseconds.
- .13 Wake-up Delay: 500 milliseconds.
- .14 Connection: 6 ft (1829 mm) cable, fine stranded with crimp terminals. 18 ga. wire
- .3 Acceptable manufacturer: LiftMaster;

Part 3– Execution

3.1 GENERAL

- .1 Location and orientation of the equipment is indicated on the drawings. Confirm final installation locations with the Consultant before beginning installation.

3.2 EQUIPMENT PADS

- .1 Construct concrete pads for all equipment.
- .2 Pads to be 100mm above slab and 25mm wider than equipment base.
- .3 Chamfer edges of pads

3.3 INSTALLATION

- .1 Confirm every system component is installed according to manufacturer recommendations and specifications, and all applicable codes.
- .2 The systems must be installed by a manufacturer-certified representative.
- .3 Configure and program the access control system to function as per the requirements of this specification and integrate into the facility's existing access control system. The facility manager will provide access to their server.
- .4 Provide all materials, labour, accessories and peripherals to deliver a fully functioning parking access control system.

3.4 TEST

- .1 At the end of installation, make all necessary tests in the presence of the Owner.
- .2 Provide commissioning sheets for each hardware device installed.
- .3 Upon user approval of the installed system, a one-year warranty on parts will be in effect.
- .4 Provide user with a written list of equipment warranty periods.

3.5 PROGRAMMING AND TRAINING

- .1 Provide Demonstration, Operating and Maintenance Instructions by a certified manufacturer's representative.
- .2 Provide an initial three (3) hours of training to designated representatives.
- .3 Visit site 30 days following substantial performance and provide an additional three (3) hours of training.

3.6 DRAWINGS AND MANUALS

- .1 Provide system operation and technical manuals.
- .2 At the close of installation, provide record drawings on the wiring, networks and components.

3.7 VERIFICATION

- .1 Verify the equipment installed meets the specifications.
- .2 Verify wiring connections to all equipment meets applicable codes and standards.
- .3 Verify the operation of all devices.
- .4 Verify the wiring to all equipment is complete.
- .5 Provide a copy of inspecting technician's report to the Owner's Representative. Identify each device by location and certify the test results. Provide an additional copy with the O&M Manual submission.
- .6 Issue a certificate of verification to the Owner confirming the completion of the verification. Provide an additional copy with the O&M Manual submission.

3.8 PROTECTION

- .1 Protect installed products until completion of project.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.2 RELATED SECTIONS

1.2.1 Setting items in concrete: Section 03 30 00, Cast-In Place Concrete.

1.2.2 Building into masonry: Section 04 20 00, Masonry.

1.2.3 Security doors and frames: Section 08 34 20, Security Doors and Frames.

1.2.4 Finish painting: Section 09 96 10, Special Interior Coating – Epoxy Paint

1.3 REFERENCES

ASTM A53/A53M-02	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A325-04	Standard Specification for Structural Bolts, steel, Heat Treated, 120/105 Ksi, Minimum Tensile Strength
ASTM A1008/A1008M-04b	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A370-02e1	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A653/A653M-04a	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A627-03	Standard Test Methods For Tool Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities
ASTM E18-02	Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
CAN/CGSB-1.40-M97	Anticorrosive Structural Steel, Alkyd Primer
CAN/CSA G40.20/G40.21-98	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
CSA W55.3-65	Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings
CSA W59-M89	Welded Steel Construction (Metal Arc Welding)

1.4 SUBMITTALS

1.4.1 **Shop Drawings:** Submit shop drawings in accordance with Section 01 33 00 Submittals.

1.4.2 Show and describe in detail work of this Section including large scale detail of members and materials, of connection and jointing details, and of anchorage

devices, dimensions, thicknesses, description of materials, metal finishing, type of fasteners, as well as other pertinent data and information.

1.4.3 Operating and Maintenance Data

1.4.3.1 Submit instructions for operation of all detention equipment supplied under this Section.

1.4.3.2 Bind instructions into maintenance manuals as described in Section 01 71 00, Execution Requirements.

1.5 Quality Assurance

1.5.1 Qualifications

1.5.1.1 If requested, manufacturers shall provide evidence of having personnel and plant and equipment capable of fabricating solid front sliding cell doors, screens and equipment assemblies of type specified. Provide evidence of having qualified welders capable to weld material types, thicknesses and joint types typical for hollow metal doors and frames on this Project. Manufacturers shall have a minimum of 5 (five) years of experience of regularly and successfully providing types of security doors and frames required for this Project. Substantiate with list of representative Projects where security door and frames were installed including dates of Projection completion.

1.5.1.2 Work of this Section shall be by MS Security Products Ltd, Steelgate Security Products Ltd. or Strongbar Industries Inc. RL Institutional Security, Nudorco Specialty Door Products, Kach Inc, provided they meet all specified requirements.

2 PRODUCTS

2.1 MATERIALS

2.1.1 **Structural Steel Sections and Steel Plate:** sizes as detailed, CAN/CSA-G40.20/G40.21-M, Grade 300W.

2.1.2 **Sheet Steel:** Cold or hot rolled, commercial quality stretcher levelled carbon steel sheet coated to requirements of ASTM A525M with min zinc coating designation of Z275 (G90) or uncoated conforming to ASTM A366M.

2.1.3 **Tool Resisting Steel Flat Bars and Shapes:** ASTM A629, flat bars and shapes of tool resisting steel having Rockwell hardness C45 to depth of 5 mm (0.2") from outer surfaces but not penetrating to core. Case hardened open hearth steel is not acceptable. Tool resisting steel tested in accordance with ASTM A370 and ASTM E18.

2.1.4 Steel Tubing

2.1.4.1 Hollow Structural Sections: sizes as indicated, CAN/CSA-G40.20-M and CAN/CSA-G40.21-M, Grade 350W, Class H.

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- 2.1.4.2 Anchoring Devices: ASTM A325M.
- 2.1.5 **Steel Pipe:** ASTM A53 (standard weight) (extra strong) (double extra strong) (black) (galvanized) finish.
- 2.1.6 **Welding Materials:** CSA W59-M.
- 2.1.7 **Metal Filler:** Polyester based, 1 of following:
- 2.1.7.1 White Lightnin' by Marson Canada Inc., Toronto.
- 2.1.7.2 Combo or First Choice by Dura Chemicals Ltd., Hamilton.
- 2.1.8 **Viewing Window with Bullet Resistant Glass**
- 2.1.8.1 Minimum 32 mm (1-1/4") thick, laminated glass, composed of multiple plies of clear plate or float glass, sandwiched with interlayers of high tensile strength poly-vinyl butyl.
- 2.1.8.2 Glass shall conform to CAN/CGSB-12.1-M and shall be Type 1, Laminated Glass made from Class B, Plate or Float Glass. Bullet resistant glass shall be tested and meet requirements of UL No. 752, Level 1. Each lite of glass shall be clearly marked bearing UL 752 stamp affixed to lower left corner.
- 2.1.8.3 Glass shall conform to CAN/CGSB-12.1-M and shall be Type 1, Laminated Glass made from Class B, Plate or Float Glass.
- 2.1.8.4 Following products are acceptable provided they meet above requirements:
- Lamiver Inc.
 - Tempa Glass Ind Ltd.
 - Tempglass Inc.
- 2.1.8.5 No deviations in finished laminated product shall result in objectionable visual distortion as determined by Consultant.
- 2.1.8.6 Provide proof, satisfactory to Consultant that bullet-resistant glass meets specified requirements.
- 2.1.8.7 Glazing Bedding Compounds and Tapes: Solvent-free, of type compatible with laminated glass. Solvent-free polysulphide, silicone or butyl rubber based sealants may be used.
- 2.1.8.8 Provide Stainless steel sliding cover for viewing window as per drawings.
- 2.1.9 **Primer:** CAN/CGSB-1.40-M.

2.1.10 **Fasteners**

2.1.10.1 Exposed screws and nuts shall be security type. Fasteners in areas where they are not required to be removed and those on prisoner side of any construction, shall be either flat or round head, having extra head which will twist off when fully secured, leaving main head flush or projected without slots.

2.1.10.2 In areas where it is necessary to remove items, screws shall have slots or holes that require special security tool for their removal them and shall be such that standard tools will not fit.

2.1.10.3 Expansion shields for setting in concrete shall be by recognized manufacturer. Identify type of fastener shall be clearly indicated on shop drawings.

2.1.11 **Detention Hardware: to be supplied and installed under this Section as shown on drawings and to requirements of the Police Service.**

2.1.12.1 All security hardware shall meet Grade 1 performance requirements, and to meet the requirements of ASTM F1577, ASTM F1643 and ASTM F1758.

- .1 Doors shall be factory blanked, reinforced, drilled and tapped for fully templated mortised hardware in accordance with the templates provided by the hardware supplier.
- .2 Hardware reinforcement gauge or thickness shall be in accordance with the hardware manufacturer's templates.
- .3 Provide all hardware including locks, latches, handles, grips, hinges or other components as indicated on the Drawings, including the meal pass lock & hinges.

2.2 **FABRICATION**

2.2.1 **General**

2.2.1.1 Fit and assemble work in shop where possible. Execute work according to details and shop drawings. Where shop fabrication is not possible, make trial assembly in shop.

2.2.1.2 Do welding in accordance with CSA W59-M and CSA W55.3. File or grind welds smooth and flush where exposed to view in completed work and where specifically indicated on Drawings.

2.2.1.3 Fit joints and intersecting members accurately. Make work in true planes with adequate fastening.

2.2.1.4 Supply fastenings, anchors, accessories required for fabrication and erection of work of this Section. Such items occurring on or in exterior wall or slab shall be hot dip galvanized. Make thread dimensions such that nuts and bolts will fit without rethreading or chasing threads.

- 2.2.1.5 Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise indicated or specified. Keep exposed fastenings to absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.

2.2.2 **Sliding Cell Doors**

- 2.2.2.1 Construct cell doors generally as Solid Front Sliding Cell Door fronts above and equip with hardware specified under Section 08 78 00, Security Finish Hardware and as shown on drawings.

- 2.2.2.2 Fasten track sets to walls and floors with security anchors to provide rigid assembly.

- 2.2.2.3 Provide continuous vertical steel jamb with 2 adjustable rubber bumpers for sliding grille door to close against and adjustable rubber stop in track housing for door to open against.

- 2.2.2.4 Cell door glazing: Nominally 27 mm thick laminated safety glass:
.1 Cell glazing with restricted visibility glazing material: Composite safety restricted visibility glass consisting of highly reflective glazing with a PVB film, complete with an interim coating. Glazing shall prevent persons within cells to see outside of cell but still permit light transmission

- 2.2.3 **Suspended Ceiling and Transom:** Construct suspended ceiling and continuous transom over cell front by welding 5 mm (3/16") steel plates to steel angle supports, anchored to structure and welded to applicable steel components of cell wall. Cut openings for lighting fixtures and diffusers after obtaining directions and dimensions from Mechanical and Electrical Divisions. Construct ceiling access doors as indicated on Drawings and provide with hardware supplied and installed by this Section.

- 2.2.4 **Shop Painting:** Where no other type of finishing or priming is specified, clean ferrous metals and apply 1 coat of primer. Brush on and work well into crevices and interstices.

3 **EXECUTION**

3.1 **INSTALLATION**

- 3.1.1 Build and erect work plumb, true, square, straight, level and accurate to sizes detailed in accordance with reviewed shop drawings, free from distortion or defects detrimental to appearance and performance.

- 3.1.2 Insulate metals where necessary to prevent corrosion due to contact between dissimilar metals and between metals and masonry, concrete or plaster. Use bituminous paint, butyl tape, building paper or other approved means.

- 3.1.3 Install adequate instructions, templates, and, if necessary, supervise installation of fastenings or accessories requiring to be built-in by other Sections of Work handling installation.

- 3.1.4 After erection and installation, clean work and apply field touchup of same formula as shop coat primer to damaged or unpainted surface of shop primed material. Work primer well into joints, crevices, interstices and open spaces.

3.2 **SCHEDULES**

3.2.1 **General**

- 3.2.1.1 Supply and install security equipment indicated on Drawings and not included in work of other Sections in addition to items listed below. Where items are required to be built into masonry, concrete or other work supply such items to respective Sections with anchors and accessories for building in, and necessary drawings, templates and instructions.

End of Section

1 **GENERAL**

1.1 Conform to Sections of Division 1 as applicable.

1.2 **RELATED SECTIONS**

1.2.1 Installation of support: Section 06 10 00, Rough Carpentry.

1.2.2 Base Cabinets: Section 06 41 00 Finish Carpentry and Millwork.

1.3 **SUBMITTALS**

1.3.1 **Shop Drawings:** Submit fully dimensioned shop drawings showing countertop layouts, joinery, terminating conditions, substrate construction, cutouts and holes. Show plumbing installation provisions. Include elevations, section details, and large scale details.

1.3.2 **Samples:** (2) Sets selection and verification samples for each color, pattern, and finish required

1.3.3 Maintenance Data: Submit manufacturer's published maintenance manual with closeout submittals.

1.4 **QUALITY ASSURANCE**

1.4.1 **Installer Qualifications:** certified installer, certified in writing by the manufacturers.

1.5 **PROJECT CONDITIONS**

1.5.1 Field Measurements: Verify dimensions of construction to receive countertops by field measurements before fabrication.

1.6 Adhesive: Acclimatize adhesives to occupancy room temperatures with maximum temperature not to exceed 75 deg F.

1.7 **WARRANTY**

1.7.1 Manufacturer's Limited Warranty: Provide manufacturer's standard Lifetime Warranty against defects in solid surface sheet materials

2 **PRODUCTS**

2.1 **Quartz Countertop**

2.1.1 **Material:** Homogeneous mixture containing pure quartz with additions of high performance polyester resins, pigments and special effects.

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- 2.1.2 **Manufacturer:** Cambria or equal.
- 2.1.3 Composition: Quartz aggregate Acrylic resins, fire-retardant mineral fillers, and proprietary coloring agents. Through-the-body color for full thickness of sheet material.
- 2.1.4 Performance:
- 2.1.4.1 Moisture Absorption: typical results 0.02%; ASTM C97
- 2.1.4.2 Modulus of Rupture: typical results 6,800 psi; ASTM C99
- 2.1.4.3 Compressive Strength: typical results 24,750 psi; ASTM C170
- 2.1.4.4 Moisture Expansion: typical results <0.01; ASTM C370
- 2.1.4.5 Abrasion Resistance: typical results 223; ASTM C501
- 2.1.4.6 Bond Strength: minimum 210 psi; ASTM C482
- 2.1.4.7 Thermal Shock: passes 5 cycles: ASTM 484
- 2.1.4.8 Coefficient of Thermal Expansion: typical results 1.2x10⁻⁵inch/°F; ASTM C531
- 2.1.4.9 Breaking Strength of Tile: typical results 3,661 lbf; ASTM C648
- 2.1.4.10 Resistance to Freeze Thaw Cycling: unaffected 15 cycles; ASTM C1026
- 2.1.4.11 Coefficient of Friction Pull Method: .75 avg. dry/.55 avg. wet; ASTM C1028
- 2.1.4.12 Surface Burning Characteristics: typical results 17; ASTM E84
- 2.1.4.13 Smoke Density: flaming 196, non-flaming 69; ASTM E662
- 2.1.4.14 Stain Resistance: Unaffected; ANSI Z124.6
- 2.1.5 **Countertop Finish:** Two finishes to be selected by Architect.
- 2.1.6 **Finish:** Matte for Countertops.
- 2.1.7 Mounting Adhesive: Structural Grade '50 year' silicone or epoxy adhesive or type recommended by quartz manufacturer.
- 2.1.8 Joint Adhesive: Methacrylate-based adhesive for chemically bonding solid surfacing seams. Color complementary to solid surfacing sheet material. UL 2818 GREENGUARD Gold certified and complies with SCAQMD Rule 1168 or equal.
- 2.1.9 Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that comply with applicable requirements in Division 07 Section "Joint Sealants" and will not stain the solid surfacing material it is applied to.
- 2.1.9.1 Single-component, neutral-curing silicone sealant.
- 2.1.10 Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 2.2 **FABRICATION - COUNTERTOPS**
- 2.2.1 Nominal Thickness: *20 mm thick*
- 2.2.2 Edge: Double Treeline (A + R), Double Bevel; Refer to Drawings
- 2.2.3 Fabricate components in shop, to greatest extent practicable, in sizes and shapes indicated according to approved shop drawings and other manufacturer's published fabrication requirements

- 2.2.4 Form joint seams between solid surfacing components with specified seam adhesive. Completed joints inconspicuous in appearance and without voids. Provide joint reinforced if required by manufacturer for particular installation conditions
- 2.2.5 Cutouts and Holes: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Rout cutouts and complete with all edges smooth.
- 2.2.5.1 Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations.
- 2.2.5.2 Fittings: Drill countertops in shop for plumbing fittings, counter mounted soap dispensers, and similar items.

3 EXECUTION

3.1 PRE- INSTALLATION EXAMINATION

- 3.1.1 Verify dimensions by field measurements prior to installation.
- 3.1.2 Verify and examine substrates indicated to receive countertops and conditions under which solid surfacing countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EXAMINATION

- 3.2.1 Examine substrates indicated to receive countertops and conditions under which quartz countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting

3.3 CONSTRUCTION TOLERANCES

- 3.3.1 Variation from Plumb: For vertical lines and surfaces, do not exceed 1/16 inch in 48 inches.
- 3.3.2 Variation from Level: Do not exceed 1/8 inch in 96 inches, 1/4 inch maximum.

3.4 INSTALLATION OF COUNTERTOPS

- 3.4.1 Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
- 3.4.2 Install quartz components plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions. Use woodworking and specialized fabrication tools acceptable to manufacturer.

- 3.4.3 Form joint seams with specified seam adhesive. Seams to be inconspicuous in completed work. Seams in locations shown on approved shop drawings and acceptable to manufacturer. Promptly remove excess adhesive.
- 3.4.4 Provide minimum 1/2 inch radius for countertop inside corners.
- 3.4.5 Fill gaps between countertop and terminating substrates with specified silicone sealant.

3.5 CLEANING AND PROTECTION

- 3.5.1 Clean quartz surfaces according to manufacturer's published maintenance instructions. Completely remove excess adhesives and sealants from finished surfaces.
- 3.5.2 Protect completed work from damage during remainder of construction period.

End of Section

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Conform to Sections of Division 1 as applicable.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Administrative Requirements.
- .2 Indicate dimensions in relation to window jambs, operator details, head and sill anchorage details, hardware and accessories details.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove and dispose from site all packaging materials at appropriate recycling facilities.
- .2 Dispose of all corrugated cardboard, polystyrene, and plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 Products

2.1 MATERIALS AND FABRICATION

- .1 Double 6" Fascia Teleshade System with Blackout Channels – Provide at all exterior windows.
 - .1 Provide double roller with both fabric and black out fabric. Colour to be selected from manufacturer's standard colours, bottom bar to be sewn in, clear anodized aluminum as manufactured by Solarfective or equal. Roller Size: recommended by manufacturer. Fabric shall have 3% mesh and Black out fabric, Colour, finish, and window division to be confirmed with Consultant prior to ordering.
 - .2 Provide as electrically operated at Training/Briefing Room.
- .2 Fascia – provide extruded 6063-T5 aluminium fascia with anodized finish. Fascia shall hang on to extruded aluminium mounting clips and brackets without any exposed fastening devices. Fascia will not cover the top of the bracket to ensure airflow over the top of the shade and bracket assembly.
- .3 Hardware & Accessories required for Total Integrated System
 - .1 Fabloc Tube – extruded aluminium tube, 6063-T5 alloy, 2.55" O.D. with internal keyway to receive tubular motor. Tube shall be extruded with two fabric mounting channels. Channels shall be designed to accept fabloc spine.
 - .2 Fabloc Spline – extruded vinyl with asymmetrical locking channels and embossed fabric guide for use with 2.55" O.D. tube. Spline shall be snapped and locked into fabloc tube and have sufficient capacity to support fabric shade. Spline shall be readily removable without dismounting fabloc tube from end brackets.

.3 End Brackets (drive and Idler) – shall consist of 1/8" thick sheet steel. Wall, jamb or ceiling mounted as required. Shall be permanently installed to accept fascias to suit actual site conditions

.4 Fabloc Tube End Plug – Delrin end cap shall have steel pin which permits up to 5/16" lateral adjustment in tube width.

2.1.10 Closure & Hangar – Provide extruded 6063-T5 aluminium closure hanger and closure cover with anodized finish. Fastened inside the pocket.

2.1.11 Blackout Side and Bottom Channels – extruded aluminium, channels 2-1/4" x 1-1/8" to reduce light infiltration around the sides of the shades.

2.1.12 Centre Support Assembly – 1/8" thick steel bracket with vertically adjustable plastic saddle and aluminium connector axle. At the curved wall, more than one shade shall be driven by one operator through universal axles.

2.1.10 Hembar- extruded aluminium profile with hollow section, single lengths for each shade panel. Insert in fabric pocket and sew both ends

Part 3 Execution

3.1 INSTALLATION

- .1 Provide and install double fascia teleshade with manual control roller shades at exterior windows with the exception of clerestory windows.
- .2 Verify dimensions on site before preparing shop drawings
- .3 Install roller screen system in accordance with manufacturer's instructions.
- .4 Secure brackets with aluminum or stainless steel screws. Use non corrosive metal fasteners for installation, concealed in final assembly.
- .5 Install roller shades square, plumb, true to line with operable parts adjusted for correct function
- .6 Adjust to provide for operation without binding.

END OF SECTION

1 GENERAL

1.1 General Requirements

1.1.1 Conform to the Sections of Division 1 as applicable.

1.2 Description of Work

1.2.1 Security and safety film placed on glass surfaces for increased security protection and Privacy Film where required.

1.2.2 Security Film must be applied during the manufacturing process for all glazing.

1.2.3 Provide at **ALL** ground floor exterior glazing.

1.3 Related Work Specified Elsewhere:

1.3.1 Section 08 80 00 – Glass & Glazing.

1.4 References

1.4.1 International Window Film Association (IWFA)
.1 IWFA Visual Quality Standard for Applied Window Film 1999.

1.5 Submittals

1.5.1 Submit samples in accordance with Section 01 33 00 Submittals.

.1 Submit two 500 x 500 mm sample of film.

1.5.2 Submit Closeout Submittals in accordance with Section 01 78 00 Closeout Submittals.

.1 Provide operation and maintenance data for window film for incorporation into manual specified in Section.

.1 Follow manufacturers written instructions for care and maintenance of security and safety film.

.1 Use only cleaning solution recommended by manufacturer for regularly scheduled cleaning of security film.

1.6 Quality Assurance

1.6.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with legislated Health and Safety Requirements.

.2 Comply with requirements of WHMIS regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Canada Labour Code.

1.7 Delivery, Storage And Handling

- 1.7.1 Deliver, store and handle materials in accordance with General Requirements.
- 1.7.2 Provide and maintain dry, off-ground weatherproof storage.
- 1.7.3 Store rolls of film flat on cross supports. Do not stand rolls of film on end.
- 1.7.4 Remove from storage, in quantities required for same day use.
- 1.7.5 Store materials in accordance with manufacturers written instructions.

1.8 Warranty

- 1.8.1 Warrant work of this Section for a period of 12 months.
- 1.8.2 Ensure warranty includes items as follows:
 - .1 Maintaining adhesion properties without blistering, bubbling or delaminating from glass surface.
 - .2 Maintaining appearance without discolouration.
 - .3 Removing, replace and reapply defective materials.
 - .4 In event of product failure under warranty terms, remove and re-apply film without glass replacement at no cost to Owner.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 Security Film - General: optically clear polyester film , abrasion resistant coating and release liner SH14CLARL, 14 mil, 3 layers, high break strength exterior windows and doors and interior doors and sidelights as manufactured by 3M Scotchshield, or approved equal.
- 2.1.2 Privacy Film – CGI SB3 3 mil, Velvet Texture, Privacy Window Film as supplied by Convenience Group Inc..

3 EXECUTION

3.1 Preparation

- .1 Clean glass before beginning installation using neutral cleaning solution.
- .2 Ensure no deleterious material adheres to glass by scraping surface of glass using industrial razors.
- .3 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
- .4 Examine glass under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate or cause vision transparency or distortion problems. Report findings to Consultant.

- .5 Before beginning Work, place absorbent material on window sill or at sash frame to absorb moisture accumulation generated by film application.

3.2 Installation

3.2.1 Field Installation of Window Film to Windows, Door lites, Sidelights:

- .1 Install film in the same manner as tested.
- .2 Ensure no deleterious material adheres to glass by scraping surface of glass using industrial razors.
- .3 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
- .4 Examine glass under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate, or cause vision transparency or distortion problems. Report findings to Consultant before starting Work.
- .5 Install security film to glass windows ensuring no blisters, bubbles, scratches or distortions.

3.2.2 Cut film edges straight and square.

3.2.3 Cut edges 3 mm maximum from edge of glass in accordance with manufacturers written instructions.

3.2.4 Apply and attach film to glass in accordance with manufacturer's written instructions.

3.3 Splicing:

- .1 Splice film only when glass is greater in width than film.
- .2 Splice film only after receipt of written approval from Consultant.
- .3 Use only water and film slip solution on glass to facilitate positioning of film.
- .4 Ensure removal of excess water from between film and glass.
- .5 Remove left over material from work area and return work area to original condition.

3.4 Installer's Inspection

3.4.1 Visual Inspection: in accordance with IWFA - Visual Quality Standard for Applied Window Film.

3.4.2 Remove and replace without glass replacement, film that continues to show blisters, bubbles, tears, scratches, edge defects or vision distortion in film when viewed under natural daylight from 2.0 m minimum after 30 day period.

3.5 Final Cleaning

- 3.5.1 Wash interior and exterior of each window or glass panel and film using cleaning solution recommended by film manufacturer.

END OF SECTION

1 GENERAL

1.1 General Requirements

1.1.1 Conform to the Sections of Division 1 as applicable.

1.1.2 Where there is a conflict between the requirements of division 01 and the general

1.1.3 requirements of division 14, the requirements of division 01 will take precedence.

1.2 Description of Work

1.2.1 This section specifies electric traction elevators.

1.2.2 The work required under this section consists of all labour, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator as herein specified.

1.2.3 Maintenance Period: Provide labour, materials, products, equipment and services necessary for the maintenance of the elevating device. maintenance to begin at Substantial Performance and end 12 months after Substantial Performance.

1.2.4 Costs for this maintenance are to be included in the project costs.

1.2.5 Provide to the Owner a copy of the Maintenance Control Program for each device type, prior to the Substantial Performance inspection, regardless of whether maintenance of the units is included in the project scope of work. The project shall not be deemed to have reached Substantial Performance until the complete operation and maintenance manuals have been approved by the Consultant or Owner.

1.2.7 Upon acceptance by the Consultant or Owner, provide three copies of the operation and maintenance manuals in the following format: Print and bind one hard copy that will be placed in the respective machine room and two electronic copies in PDF format on an unprotected digital storage device (e.g. USB).

1.2.8 The operation and maintenance manual shall incorporate, at a minimum:

- .1 A cover page including project title, address
- .2 Table of contents, index
- .3 Contact details for the respective parties
- .4 Warranty letter signed by a representative of the contractor having authority to bind the company
- .5 Controller and drive manuals, including: a description of the controller user interface; the installation and user's manuals; a list of fault and error codes, including an explanation of meanings and corrective actions; troubleshooting and diagnostic procedures, methods of use and the adjustment of programmable parameters together with their settings at the time of final adjustment.
- .6 As-built wiring diagrams
- .7 The operation of the equipment including special features, dispatching sequences, and such items as intercom systems and security and access control systems.
- .8 Step-by-step instructions for the operation for special features such as

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- Firefighters' Emergency Operation, Independent service and Emergency Power service.
 - .9 As-built diagrams and drawings of operating panel (e.g. car panel, central control console) with descriptions of the function of switches and indicators;
 - .10 A copy of the final submission to the Authority Having Jurisdiction and a copy of the final inspection report.
 - .11 Operation and maintenance manuals for all other major components.
 - .12 Supplier and part name for other parts (ex: travelling cable, restrictors, retainers, interlocks, car top inspection station, guide means, etc.), excluding minor or generic items such as screws, bolts, hinges, etc.
 - .13 Full instructions for any special maintenance procedure, repair protocol, adjustment or test not addressed by Code (including the A17.2 and the Elevator Industry Field Employee's Safety Handbook);
 - .14 Manufacturer's recommended maintenance intervals for each major component.
 - .15 A copy of the Maintenance Control Program signed and sealed by a licensed Engineer in jurisdictions where required by the applicable authorities (ex. Quebec).

1.3 Related Work Specified Elsewhere:

- 1.3.1 Coordination with other trades: Where the work joins another trade, provide drawings showing the actual dimensions and the method of joining the work to the work of the other trade and information such as anchors, templates and details for cast-ins.
 - .1 Division 3 – Concrete
 - .2 Division 4 – Masonry
 - .3 Division 5 – Metals
 - .4 Division 7 – Thermal & Moisture Protection
 - .5 Division 8 – Doors & Windows
 - .6 Division 9 – Finishes
 - .7 Division 22 – Plumbing
 - .8 Division 23 – Mechanical
 - .9 Division 26 – electrical
 - .10 Relevant sections for work by security, access control, audio-visual and communications sections.
- 1.3.2 Provide access and assistance as required, at no extra charge, in relation to work by other trades.

1.4 References

- 1.4.1 ASME A17.1-2013/CSA-B44-16 - Safety Code for Elevators and Escalators.

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- 1.4.2 American Society for Testing and Materials (ASTM): All applicable sections.
 - 1.4.3 CAN/ULC-S104-15 - Standard Method for Fire Tests of Door Assemblies.
 - 1.4.4 CAN/CSA-B651-18 - Accessible Design for the Built Environment.
 - 1.4.5 CSA-B44.1-14/ASME-A17.5-2014 - Elevator and Escalator Electrical Equipment.
 - 1.4.6 CSA-C22.2 No. 100-04 (R2009) - Motors and Generators.
 - 1.4.7 CSA S832(R2019) - Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings.
 - 1.4.8 CSA-W55.3-08 - Certification of Companies for Resistance Welding of Steel and Aluminum.
 - 1.4.9 NEMA LD3-2005 - High Pressure Decorative Laminates (HPDL).
 - 1.4.10 NFPA 80-2016 – Standard for Fire Doors and Other Opening Protectives.
 - 1.4.11 NFPA 252-2012 – Standard Methods of Fire Tests of Door Assemblies.
 - 1.4.12 SSPC (The Society for Protective Coatings) - Steel Structures Painting Manual.
 - 1.4.13 Health Canada/Workplace Hazardous Materials Information System (WHMIS): Material Safety Data Sheets (MSDS).
 - 1.4.14 Ontario Building Code.
 - 1.4.15 Ontario Elevator Code and applicable standards.

1.5 Submittals

- 1.5.1 Submit samples in accordance with Section 01 33 00 Submittals.
 - .1 Submit samples of interior car finishes for floor, walls, doors, ceiling and other components.
- 1.5.2 Submit Closeout Submittals in accordance with Section 01 78 00 Closeout Submittals.

1.6 Quality Assurance

- 1.6.1 Health and Safety:
 - .1 Carry out construction occupational health and safety in accordance with legislated Health and Safety Requirements.
 - .2 Comply with requirements of WHMIS regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Canada Labour Code.
- 1.6.2 Quality Assurance:
 - .1 Elevator manufacturer shall be ISO 9001 certified.
 - .2 Manufacturer shall have a minimum of fifteen years of experience in the fabrication, installation and service of elevators.
 - .3 Elevators shall be installed by the manufacturer.

1.7 Delivery, Storage and Handling

- 1.7.1 Deliver, store and handle materials in accordance with General Requirements.
- 1.7.2 Provide and maintain dry, off-ground weatherproof storage.
- 1.7.3 Remove from storage, in quantities required for same day use.

1.7.4 Store materials in accordance with manufacturers' written instructions.

1.8 Warranty

1.8.1 Warrant work of this Section for a period of 12 months. Warranty shall cover defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

2 PRODUCTS

2.1 DESCRIPTION

2.1.1 Elevator Type: Gearless machine-room less elevator where all components fit inside the hoistway with the controller in the top landing entrance frame.

2.1.2 Approved Manufacturer & Model: Otis, Gen 3 Edge with Otis GCS Controller.

2.1.3 Elevator Characteristics:

- .1 Regenerative drive
- .2 3 stops, openings front and rear at both levels.
- .3 Travel: 4500mm nominally
- .4 Rated Capacity: 2100
- .5 Rated Speed: 200 ft/min
- .6 Platform size: 5'-9 1/2" x 5'-6"
- .7 Clear inside dimensions: 5'-8" x 4'-4"
- .8 Cab height: 93" (7'-4" clear)
- .9 Entrance: single slide 3'-0" x 84" high
- .10 Operation: Simplex Collective Operation.
- .11 Operation Features: full collective operation, anti-nuisance, fan/light protection (vandal-resistant), load weighting bypass, emergency services operation, top of car inspection

2.1.4 Door Operation & Door Controls: Automatic door operator to operate car and hoistway doors. Opening and closing speed to suit requirements of Appendix E of Elevator Safety Code. Open doors automatically when car arrives at the floor, provided access has been granted by the access control system. Door Safety Devices: Electronic multi-beam safety edges.

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- 2.1.5 Access Control: Movement to any floor, and access from the elevator car to the Police zone on Levels 1 and 2 shall only be possible when granted by the access control system. Provide panel space and coordinate placement of a card reader within the elevator car.
 - 2.1.6 Leveling Device: Stop elevator within 6mm under any loading condition or direction of travel.
 - 2.1.7 Main Power Supply & Lighting: 600 Volts, 3 Phase, 60 Hz, Lighting Power Supply: 120 Volts, 1 Phase, 15 Amp, 60 Hz
 - 2.1.8 Interconnect elevator control system with building fire alarm system.
 - 2.1.9 Seismic Design: In accordance with applicable code, specified seismic design for post disaster buildings, construction requirements of Contract Documents, and CSA S832.
 - 2.1.10 Independent Service: Key-activated service to remove and return car from normal operation and cancel all pre-registered car calls.
 - 2.1.11 Emergency Operation: Provide Firefighter Emergency Operation to the latest edition of the ASME A17.1/CSA-B44 and specification. Provide Emergency Power Operation to operate elevator in the event of a power interruption.
 - 2.1.12 Elevator contractor is responsible to provide pit access ladder.

3 EXECUTION

3.1 Examination

- 3.1.1 Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.
- 3.1.2 Demonstration: The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

3.2 Preparation

- .1 Arrange for temporary electrical power for installation work and testing of elevator.

3.3 Installation

- 3.3.1 Install in accordance with the ASME A17.1/CSA-B44, CSA-B44.1, CSA-W55.3 all local codes/ legislation and manufacturer's installation instructions.
- 3.3.2 Install system components. Connect equipment to building utilities.
- 3.3.3 Provide all required conduit, boxes, wiring, and accessories.
- 3.3.4 Install, mount and support all components as recommended by the manufacturer.

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- 3.3.5 Accommodate equipment in space indicated.
 - 3.3.6 Accurately machine and align guide rails. Form smooth joints with machined splice plates.
 - 3.3.7 Provide inserts, in timely manner and with clear instructions, to be placed in hoistway wall(s), including pit wall(s), as hoistway is being constructed.
 - 3.3.8 Bolt brackets to inserts placed in concrete form work that will perform to four times the rated pull-out load.
 - 3.3.9 Coordinate installation of hoistway wall construction.
 - 3.3.10 Install hoistway door sills, frames, and headers in hoistway walls. Grout sills in place. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.
 - 3.3.11 All communication devices required by the latest edition of the ASME A17.1 / CSA B-44 Safety Code for Elevators are to be provided by the elevator contractor.
 - 3.3.12 Adjust equipment for smooth and quiet operation.
 - 3.3.13 The same lead mechanic must be assigned to the project from beginning to end. They
 - 3.3.14 must not be assigned to another project, even temporarily, while the elevator contractor has personnel working on-site. In addition, the lead on-site mechanic must hold a valid Class A, Elevating Device Certificate of Competency.

3.4 Field Quality Control

- 3.4.1 Perform tests required by ASME A17.1/CSA-B44 and Authority Having Jurisdiction.
- 3.4.2 Obtain required permits to perform tests. Perform tests required by Authority Having Jurisdiction, schedule tests with agencies and Consultant, Furnish test and approval certificates issued by Authority Having Jurisdiction

3.5 Adjusting

- 3.5.1 Adjust for smooth acceleration and deceleration of car so not to cause passenger discomfort.
- 3.5.2 Adjust automatic floor leveling feature at each floor to achieve 6mm from flush.

3.6 Cleaning & Protection of Finished Work

3.6.1 Clean as per Section 01 74 00 - Cleaning.

3.6.2 Protect all car and door finishes until all work is completed in the area.

3.6.3 The elevator is not to be used by construction personnel or for the movement of tools or materials.

3.6.4 Use of the elevator for deliver of furniture and/or equipment by the Owner shall be discussed and agreed in writing with the Contractor.

END OF SECTION

**SECTION 23 05 23.02
VALVES - CAST IRON**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS (NOT USED)

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME):
 - .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings
- .2 ASTM International (ASTM):
 - .1 ASTM A49-01, Standard Specification for Heat-Treated Carbon Steel Joint Bars
 - .2 ASTM A126-04, Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - .1 MSS SP-61-03, Pressure Testing of Steel Valves
 - .2 MSS SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends
 - .3 MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends
 - .4 MSS SP-82-1992, Valve Pressure Testing Methods
 - .5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends

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 for valves 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 Ontario, Canada.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:

- .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70
 - .2 Globe valves: MSS SP-85
 - .3 Check valves: MSS SP-71
- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B209 Class B.
 - .2 Connections: flanged ends plain face with 2 mm raised face with serrated finish to ANSI B16.1
 - .3 Inspection and pressure testing: to MSS SP-82
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62
 - .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

2.2 GATE VALVES

- .1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B62
 - .3 Seat rings: renewable bronze to ASTM B62, screwed into body
 - .4 Stem: bronze to ASTM B62

- .5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem
- .6 Seat: integral with body.
- .7 Stem: wrought steel.
- .8 Operator: handwheel or T handle service box wrench.
- .2 NPS 10 - 24, non rising stem, inside crew, bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: cast iron to ASTM A126 Class B for sizes up to NPS 14, Class C for sizes NPS 16 and over, with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges.
 - .2 Pressure ratings: Class 125.
 - .3 Disc: solid offset taper wedge, with bronze rings to ASTM B62 rolled into cast iron disc, secured to stem
 - .4 Seat rings: renewable bronze to ASTM B62 screwed into body
 - .5 Stem: bronze to ASTM B62
 - .6 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.
 - .7 Stem: wrought steel.
 - .8 Operator: handwheel or T handle service box wrench.

2.3 UNDERWRITERS APPROVED GATE VALVE

- .1 NPS 2 1/2 - 14, OS&Y:
 - .1 Approvals: UL and FM approved for fire service
 - .2 UL and FM Label: on valve yoke
 - .3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC C-262 (B).
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements
 - .5 Packing gland: bronze.
 - .6 Stem: manganese bronze. Diameter to ULC C-262 (B). Brass, ASTM B16.
 - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B)
 - .8 Bosses for bypass valve, drain: on NPS 4 and over.
 - .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: EPDM coated cast iron with bronze disc rings.
 - .10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.
 - .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
 - .2 NPS 14-1.2: 1.2 MPa CWP.
 - .12 Operator: handwheel.

- 2.4 GLOBE VALVES (NOT USED)**
- 2.5 BYPASSES FOR GATE AND GLOBE VALVES (NOT USED)**
- 2.6 VALVE OPERATORS (NOT USED)**
- 2.7 CHECK VALVES (NOT USED)**
- 2.8 SILENT CHECK VALVES (NOT USED)**

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

**SECTION 26 42 00
CATHODIC PROTECTION**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS (NOT USED)

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.3 No. 4-1974 (R2004) Control of Electrochemical Corrosion of Underground Metallic Structures.
- .2 National Association of Corrosion Engineers (NACE)
 - .1 NACE SP0169-2007, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets for cathodic protection 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 Ontario, Canada.
 - .2 Indicate location of anodes, test positions, connecting cables, wire splicing details, installation procedures, power supply, hardware 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:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Provide complete cathodic protection system to OPSS 442, to NACE SP0169, CSA 22.3 No.4 and comprising galvanic or impressed current anodes with design life, of 30 years minimum.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install system including bonding of structure as indicated.
- .2 Locate test stations in weatherproof housings as indicated.
- .3 Make joints and connections by means of thermit welding.
 - .1 Bond pipelines to structure.

3.2 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

ISSUED FOR TENDER

**MECHANICAL & ELECTRICAL
SPECIFICATIONS FOR:**

**Hanover Police Service
203, 10th Street
Hanover, Ontario**

**V&R Project NO. 25-122
August 13, 2026**

Vanderwesten & Rutherford Associates Inc.

Consulting Mechanical & Electrical
Engineers
7242 Colonel Talbot Road
London, ON N6L 1H8



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General

1.1 GENERAL REQUIREMENTS

- .1 Read and meet requirements of:
 - .1 The Contract CCDC 2-2020, Stipulated Price Contract as amended.
 - .2 Division 01 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 and 25.
- .6 Variable frequency drives for motors and equipment supplied under Mechanical Divisions 20, 21, 22, 23 and 25.
- .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 and 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 and 25 will 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 will be by Electrical Division 26. Wiring and connections from VFD to motors under Mechanical Divisions 20, 21, 22, 23, 25 will be by Electrical Division 26.
- .3 Flashings for mechanical equipment and services located on or passing through roofs will 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 will be supplied under Division 09.
- .5 Concrete equipment bases, housekeeping pads, sump pits and trenches will 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 a copy 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 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 will return electronic copy, marked with comments and 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 will 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 a 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 (eg. 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 a 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, three (3) copies of Operation and Maintenance Manuals, consolidated in black hardcover 3 "D" ring binders, each binder sized to include 25% spare space for future data, and one (1) PDF format on USB drive clearly marked and labelled accordingly.
 - .2 Ensure the binder spines have typewritten lettering as follows:

OPERATION & MAINTENANCE MANUAL

for

Hanover Police Station

[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 corrects 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.
 - .6 Building Automation System (BAS) graphics
- .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 will be made after letting of contract for any expenses incurred through failure to do so. No extras will 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 will 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's Physical Plant Department. 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 Material 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 Material 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.
- .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 EQUIVALENTS AND ALTERNATIVES

- .1 Suppliers wishing approval for additional equipment items as equivalent to those specified must submit complete description, technical and performance data to consultant at least ten (10) working days before Bid closing date. Such equivalent equipment, if accepted, meet the requirement specifications with regards to all details, accessories, modifications, features, and performance. Deviations from specifications must be stated in writing at time of submission for approval.
- .2 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, and space revisions to associated equipment, controls, etc. shall be included in alternative price. Prior approval by consultant is not required for unsolicited alternative proposals.
- .3 Where the 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.

2.4 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 will be permitted without written authorization from the Consultant.

2.5 CONSULTANT'S REVIEW

- .1 The consultants 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.
- .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 will any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which will 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 will 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 will 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 will 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 COMMISSIONING

- .1 Refer to Section 01 80 50 Commissioning.
- .2 The Contractor shall start-up and completely commission all equipment and systems installed and/or modified under this contract. Commissioning work shall be completed to the satisfaction of the Consultant prior to acceptance of the Work or any part thereof.
- .3 Commissioning shall meet the requirements of CAN/CSA Z318.0 Commissioning of Health Care Facilities
- .4 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.
- .5 The Contractor and his sub-contractors shall each assign an individual representing each of the relevant trades to the commissioning team and shall ensure that representatives of the equipment manufacturers are present during the relevant commissioning tasks.
- .6 The Contractor shall provide all necessary labour, materials, equipment, testing apparatus and incidentals necessary to completely start-up, verify, test and commission each system provided as part of the Work.
- .7 Each Section shall prepare Check Sheets in accordance with the standards listed above and shall issue them to the commissioning team for use during the commissioning process.
- .8 Three (3) copies of commissioning manuals shall be provided, bound in hard cover D-ring binders (not to exceed 4") with transparent cover on front and spine personalized to indicate;
 - .1 Name and logo of Health Care Facility,
 - .2 Name of the project,
 - .3 The Owner's project number,
 - .4 Identification of the system commissioned,
 - .5 The date that the system was commissioned.
- .9 Commissioning manuals shall include machine printable index dividers to organize each manual by system and by commissioning stage.

3.11 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 Door Hardware (Hold-Open Devices, Electromagnetic Locks, etc.)
- .7 Smoke Control Systems
- .8 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 will 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 CAN/CSA-W117.2, Safety in Welding, Cutting and Allied Processes
 - .5 CAN1-B149.1 Natural gas and propane installation code.
 - .6 CSA B64.1 Manual for the Selection and Installation of Backflow Prevention Devices
 - .7 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: Nondestructive 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
 - .2 NFPA 13 - Installation of Sprinkler Systems.
 - .3 NFPA 14 - Installation of Standpipe, Private Hydrants, and Hose Systems.
 - .4 NFPA 17 – Standard for Dry Chemical Extinguishing Systems
 - .5 NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection
 - .6 NFPA 30 – Flammable and Combustible Liquids Code

- .7 NFPA 45 – Standard on Fire Protection for Laboratories Using Chemicals
- .8 NFPA 55 – Compressed Gases and Cryogenic Fluids Code
- .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 Spirax Sarco SB
 - .2 Armstrong International
 - .3 Crane
 - .4 Conbraco
 - .5 Colton Industries
 - .6 Victaulic
 - .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 Water 1/32" (0.8 mm)
 - .2 Glycol 1/32" (0.8 mm)
 - .3 Water @ Pump Suction 1/8" (3.2 mm)
 - .4 Light Oil 1/16" (1.6 mm)
 - .5 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 Water 1/16" (1.6 mm)
 - .2 Glycol 1/16" (1.6 mm)
 - .3 Water @ Pump Suction 1/4" (6.4 mm)
 - .4 Light Oil 1/16" (1.6 mm)
 - .5 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
- .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 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."**

2.6 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.

2.7 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.

2.8 PRESSURE GAUGES

- .1 Manufacturers:
 - .1 Trerice Model 600BC.
 - .2 Weiss
 - .3 Winter
 - .4 Morrison
 - .5 Taylor
- .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.

2.9 STEM TYPE THERMOMETERS

- .1 Manufacturers:
 - .1 Terice Model BX9 2 403.
 - .2 Weiss Model 9VS3-1/2.
 - .3 Winter
 - .4 Morrison
 - .5 Taylor
- .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.

2.10 DIAL THERMOMETERS

- .1 Manufacturers:
 - .1 Terice
 - .2 Weiss.
 - .3 Winter.
 - .4 Morrison.
 - .5 Taylor
- .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.

OR
- .3 Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
 - .1 Size: 3" (75 mm) diameters dial.
 - .2 Lens: Clear glass.
 - .3 Accuracy: 1 percent.
 - .4 Calibration: Degrees F.

OR
- .4 Thermometer: ASTM E1, stainless steel case, vapour or liquid actuated with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer glass lens.
 - .1 Size: 2-3/8" (60 mm) diameters dial.
 - .2 Lens: Clear glass.
 - .3 Length of Capillary: Minimum 60" (1500 mm).
 - .4 Accuracy: 2 percent.
 - .5 Calibration: Degrees C Both degrees F and degrees C.
- .5 Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- .6 Flange: 3" (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.11 TEST PLUGS

- .1 Manufacturers:
 - .1 Pete's Plug.
 - .2 Watts TP.

- .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.

2.12 STATIC PRESSURE GAUGES

- .1 Manufacturers:
 - .1 Tserice
 - .2 Weiss.
 - .3 Winter.
 - .4 Taylor.
- .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.

2.13 ACCESS DOORS

- .1 Manufacturers:
 - .1 Acudor
 - .2 CEB
 - .3 MIFAB
 - .4 Cendrex Contour
- .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 or Stainless steel type 304, No. 4 satin polish.
 - .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, Acudoor UF-5000 Stainless.
- .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 or Stainless steel type 304, No. 4 satin polish.
 - .5 Manufacturers Model: Acudoor FW-5050/FB-5060 to match fire separation.

2.14 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 will delay delivery of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment will 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 inverter 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.

2.15 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.

2.16 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.

2.17 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.

2.18 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.

2.19 SLEEVES

- .1 Materials: minimum schedule 20 galvanized steel or cast iron.

2.20 ESCUTCHEONS

- .1 Finish: Polished chrome

2.21 FLASHINGS AND COUNTERFLASHINGS

- .1 Thaler or equivalent mechanical/electrical flashings as recommended for specific purpose.
- .2 Stainless steel flashing sleeve, integral deck flange and EPDM seal.

2.22 PENETRATION SEALS

- .1 Manufacturer: Link-Seal
- .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.

2.23 FIRE BARRIER PLASTIC PIPE DEVICE

- .1 Manufacturers:
 - .1 3M PPD
 - .2 Hilti Firestop Systems
- .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" (150mm) non-metallic piping penetrating up to a 2-hour fire rated assembly.
 - .3 Tested to ASTM E814 (ANSI/UL 1479) and CAN/ULC-X115 Standard Method of Fire Tests for Through Penetration Fire Stops.

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 connect.
- .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 will 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.
 - .5 Victaulic installers to be trained by Victaulic.
- .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 Commissioning Agent
 - .3 The Owner's Representative
 - .4 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 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.

3.9 TESTING AND BALANCING

- .1 Allow sufficient time for testing and verification before substantial completion. Notify Testing and Balancing Agency on completion of adjusting and balancing of systems.
- .2 Adjust systems and components (drives, sheaves, belts, etc.) as required by Testing and Balancing Agency.
- .3 Maintain systems in full operation during testing and verification.
- .4 Make adjustments to control systems as required to facilitate verification. Maintain all safety controls in operation.
- .5 Check and correct alignment of V-belts, drive shaft coupling drives, etc. as required by Testing and Balancing Agency.
- .6 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 will 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.

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 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 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, will 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 will 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 remainder 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

- .1 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.

3.18 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.

3.19 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.

3.20 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.

3.21 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.

3.22 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.

3.23 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.

3.24 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.

3.25 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.

3.26 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.

3.27 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.

3.28 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.

3.29 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 Install plastic tape pipe markers complete around bare pipe to manufacturer's instructions.
- .8 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.
- .9 Clearly identify abandoned services left in place as "ABANDONED".
- .10 Mark radioisotope drainage piping and exhaust air ductwork with radiation warning symbols and name label at 10 ft. (3 m) intervals and at all branch connections, valves and access panel locations. Identify fan system number at each ductwork label.
- .11 Install underground plastic pipe markers 6"-8" (150-200 mm) below finished grade, directly above buried pipe.
- .12 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.
- .13 Identify control panels and major control components outside panels with plastic nameplates.
- .14 Identify valves in main and branch piping with tags. Consecutively number valves in each system.
- .15 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.
- .16 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."**
- .17 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.

3.30 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
Ductwork	Label all ductwork showing system type Supply, Return, and Exhaust system numbers		

3.31 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.

3.32 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.

3.33 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.

3.34 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.

3.35 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 start 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.

3.36 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.

3.37 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

3.38 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

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

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

3.39 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

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

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

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 Factor: 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).
 - .5 Steam (100psig WP): 350°F (177°C).
 - .6 Steam (15psig WP): 300°F (150°C).
 - .7 Condensate (to 125 psig): 350°F (177°C).
 - .8 Condensate & Feed water (to 300 psig): 500°F (260°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
- .3 Expansion Joints
 - .1 Flex-Pression Ltd.
 - .2 Hyspan Precision Products, Inc.
 - .3 Senior Flexonics
- .4 Pipe Alignment Guides
 - .1 Flex-Pression Ltd.
 - .2 Hyspan Precision Products, Inc.
 - .3 Senior Flexonics

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 EXPANSION JOINTS - DESIGN 300 PSIG / 500°F

- .1 Ratings
 - .1 Design Pressure: 300 psig (2070 kPa)
 - .2 Test Pressure: 450 psig (3105 kPa)
 - .3 Design Temperature: 500 °F (260°C)
- .2 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.

2.7 LAMINATED, ULTRA-LOW PRESSURE FORCE

- .1 Ratings:
 - .1 Design Pressure: 150 PSIG 300 PSIG
 - .2 Test Pressure: 225 PSIG 450 PSIG
 - .3 Maximum Temperature: 500 F.
- .2 Basis of design: Hyspan series 1501-1506.
- .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 will 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.

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

- .7 Internal liners of stainless steel shall remain within the joint over all dimensions under design motions.
- .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 as specified.
- .10 Butt weld ends of schedule standard A53 Gr. B (or A106 Gr. B).
- .11 Dual joints must include an intermediate anchor base.

2.8 LAMINATED, ULTRA-LOW PRESSURE FORCE

- .1 Ratings:
 - .1 Design Pressure: 150 PSIG
 - .2 Test Pressure: 225 PSIG
 - .3 Maximum Temperature: 500 F.
- .2 Basis of design: Hyspan series 1501/1502 HYRISER.
- .3 Expansion joints shall be low area, three-ply, internally pressurized designs, single configuration incorporating an internal guide liner.
- .4 Integral pipe attachments must have a radius where the bellows neck is received.
- .5 Expansion joints with larger effective area or axial spring rate welded to the pipe OD, not of three plies, or attached to a pipe without a radius will 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.

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

- .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.

2.9 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 vanstone as indicated on the schedule. Carbon steel vanstone 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.

2.10 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

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

2.11 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 will 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: 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: 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 will 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

2.12 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.

2.13 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 will be included on each slip tube. Limit-stop pins are not acceptable.
- .4 The slip tube will 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 will 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 will be Hyspan Series 6500 Perma-Pax .

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

2.14 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 will 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 will 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

2.15 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-BarcoStyle III High Performance Type N ball joints **or** Hyspan-BarcoStyle III High Performance Type N ball joints with Type V Injectors

2.16 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 will 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 will 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 the 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 supports.
- .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 Myat
 - .3 Copper B-Line
 - .4 Unistrut
 - .5 Erico
- .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 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.

2.3 ROOFTOP PIPE/DUCT SUPPORTS

- .1 Manufacturers;
 - .1 Portable Pipe Hangers, Inc.
 - .2 Trikon Systems
 - .3 Thaler
 - .4 Bigfoot
 - .5 ASP Base
 - .6 Eco Foot
 - .7 Unistrut-Unipier
- .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 licenced 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 will 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 3" (75 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 counterflash, and seal.
- .3 Flash floor drains in floors with topping over finished areas with lead, 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 counterflash 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 air tight. 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
3/4	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	

.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	

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 Restraint

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 INERTIA BASES

- .1 Structural Bases:
 - .1 Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
 - .2 Construction: Welded structural steel with gusseted brackets, supporting equipment and motor with motor slide rails.
- .2 Concrete Inertia Bases:
 - .1 Mass: Minimum of 1.5 times weight of isolated equipment.
 - .2 Construction: Structured steel channel perimeter frame, with gusseted brackets and anchor bolts, adequately reinforced, concrete filled.
 - .3 Connecting Point: Reinforced to connect isolators and snubbers to base.
 - .4 Concrete: Reinforced 20 mPa concrete.

2.3 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
REFRIGRATION 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	4	025 (6)	A	4	0.75 (19)	A	4	1.50 (38)	A	4	1.50 (38)	--
	Air-Cooled Recip., Scroll	All	All	A	1	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)	A	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)	C	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)	C	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)	C	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)	C	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 to 93)	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)	--
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,	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

PLENUM FANS, CABINET FANS, FAN SECTIONS, CENTRIFUGAL INLINE FANS	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
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	B	3	0.75 (19)	C	3	1.50 (38)	C	3	2.50 (64)	C	3	2.50 (64)	2,3,4, 9

			500													
			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.
13	Compressors: The two basic reciprocating compressors are duct structures. (1) single and double cylinder vertical, horizontal or L-head, which are usually

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
BASE TYPE D	Model CIB-SS
	Roof Curb Rail
	Model KSR
	Model KSCR
ISOLATOR TYPE 1	Roof Curb Rail
	Model ESR
	Fibreglass Isolation Pad
	Model KIP
	Neoprene Isolation Pad
ISOLATOR TYPE 2	Model NP
	Model NG
	Model RSP
	Fibreglass Isolation Mount
	Model AC

	air compressors, and (2) Y,W, and multi head or multi cylinder air and refrigeration compressors. Single 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.		Neoprene Isolation Mounts Model RD Model RQ Isolation Hangar Model FH Model RH
14	Compressors: When using Y,W and multi head and multi 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 supplier 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	ISOLATOR TYPE 3	Free-Standing Steel Spring Model FDS House Spring Isolators Model SL Model SM Isolation Hangar Model SFH Model SRH Model SH
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.	ISOLATOR TYPE 4	Restrained Spring Isolator Model TITAN Model FMS Model FLS Model FLSS Model FHS Model FRS
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	ISOLATOR TYPE 5	Thrust Restraint Model HSR
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, $0.4 \times 275 = 110$ 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 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 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 Testing, adjustment, and balancing of smoke management systems.
- .5 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, 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, an 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.
- .3 Prequalified agencies include;
 - .1 (GTA, Hamilton & Niagara)
 - .1 Clark Balancing Ltd.
 - .2 Dynamic Flow Balancing
 - .2 (London)
 - .1 C.J. Zettler & Associates Ltd.
 - .2 D.J Troupe & Associates
 - .3 Caltab
 - .3 (Kitchener - Waterloo)
 - .1 C.J. Zettler & Associates Ltd.
 - .2 Air Audit
 - .3 Clark Balancing Ltd.

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.

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 Coordinate verification of smoke control and automatic sprinkler systems with verification of fire alarm system under Division 26.

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 has not been 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 50% of manufacturers' recommendations for final pressure at fans with fixed speed drives and 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.
- .15 On fan powered VAV boxes, adjust air flow switches for proper operation.

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 Heat Exchanger:
 - .1 Identification/number
 - .2 Location
 - .3 Service
 - .4 Manufacturer
 - .5 Model number
 - .6 Serial number
 - .7 Primary water entering temperature, design and actual
 - .8 Primary water leaving temperature, design and actual
 - .9 Primary water flow, design and actual
 - .10 Primary water pressure drop, design and actual
 - .11 Secondary water leaving temperature, design and actual
 - .12 Secondary water leaving temperature, design and actual
 - .13 Secondary water flow, design and actual
 - .14 Secondary water 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, Commissioning Agent and the Owner for review and approval. Discuss comments offered by the Consultant, Commissioning Agent 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 a record of the nameplate data for each equipment item and each associated motor,
 - .3 a list of observations appropriate to the 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. Advise 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 as tests are conducted.
- .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: visually inspect and verify the direction of motor rotation. It is possible for motor rotation to have been checked by the electrician 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 have been 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 will 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 determine if it has been treated and is clean.
- .6 Check and record type and concentration of glycol in systems which require freeze protection.
- .7 Check pump rotation.
- .8 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).
- .9 Check open expansion tanks to make sure they are not air bound and that the system is full of water.
- .10 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.
- .11 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.
- .12 Verify operation of automatic bypass valve.
- .13 Verify operating temperature of heat exchangers, to design requirements.
- .14 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 drop and flow through each coil.
 - .4 Pump operating suction and discharge pressure and final t.d.h. and flow delivered.
 - .5 Pressure drop across bypass valve.
 - .6 All mechanical specifications of pumps.
 - .7 Rated and actual running amperage of pump motor.
- .15 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 drybulb 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. Identify 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.

3.12 SMOKE CONTROL SYSTEMS

- .1 Test all smoke control measures in conformance with requirements of the Ontario Building Code, (OBC), Ontario Fire Code (OFC), National Building Code (NBC) and Supplements thereto, the standards of the National Fire Protection Association (NFPA), and ASHRAE Guideline 5.
- .2 Instruct installing Contractors on any adjustments necessary and retest until performance satisfactory to building authorities is achieved.
- .3 Record and report results to 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 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
- .3 Breeching Insulation

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.
- .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 will 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
- .2 Insulation: ASTM C553; flexible, noncombustible.
 - .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, max. VOC content of 80g/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
- .2 Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
 - .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, max. VOC content of 80g/L.

2.3 PHENOLIC INSULATION

- .1 Manufacturers:
 - .1 Manufacturer: Resolco International by "Insul-Phen"
 - .2 Other Manufacturers: in accordance with 20 01 01.
- .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: 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 bar [29 psi]
 - .5 Thermal conductivity: 0.13 BTU-in/hr-ft-°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 Permanance: 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 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 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 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 Resolco approved fabricator from Resolco 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 your local Resolco 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. 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 .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 nonfood 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 Joints
- .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.
- .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 Insulation: ASTM C552 "Standard Specification for Cellular Glass Thermal Insulation",
 - .1 'k' Value: 0.039 at 24 degrees C.
 - .2 Maximum Service Temperature: 482 degrees 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 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°)	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)
- .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*

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 Fibre glass 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 Fibre glass 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 68°F - 750°F (20°C - 400°C)		
Item	Thickness (Inches)	Thickness (mm)
Heating Glycol Pumps including Fittings & Accessories	2"	50 mm
Flash Tanks	2"	50 mm
Expansion Tanks, Air Separators	2"	50 mm
Heat Exchangers	2"	50 mm
Radiant Ceiling Panels	2"	50 mm
Any Other Equipment Operating at High Temp.	2"	50 mm

Flexible Elastomeric Unicellular Sheet - Cold Surfaces		
Item	Thickness (Inches)	Thickness (mm)
Evaporators, Coolers, Compressors	1-1/2"	38 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 fibre glass 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 will 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
- .2 Insulation: ASTM C547; rigid moulded, noncombustible.
 - .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 PRE-FORMED MINERAL WOOL

- .1 Manufacturers:
 - .1 ROXUL ProRox PS 960
- .2 Insulation: ASTM C547; rigid moulded, non-combustible.
 - .1 'ksi' value: ASTM C335
 - .2 Minimum Service Temperature: -20°F (-28.9°C).
 - .3 Maximum Service Temperature: 302°F (150°C).
 - .4 Maximum Moisture Absorption: less than 1% by weight
- .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.

2.3 PHENOLIC INSULATION

- .1 Manufacturers:
 - Resolco International bv "Insul-Phen"
 - Tektix
- .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/ft³ (40-kg/m³)
 - .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-ft²-°F (18.72 W-mm/m²-°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.

2.4 ELASTOMERIC INSULATION

- .1 Manufacturers:
 - .1 Armacell APArmaflex
 - .2 APArmaflex W
 - .3 APArmaflex SS
 - .4 APArmaflex SA.
- .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 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-Ft ² -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.

2.6 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

- .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.

2.7 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

2.8 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 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 ends 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 hanger 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.
- .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).
- .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.
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 & glycol/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

	201 to 250	1-1/2" and larger	4-1/2
		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
		2-1/2 to 6	2
	FLEXIBLE INSULATION		
Service			Insulation Thickness
Horizontal storm and sanitary drainage			1"
Radiant ceiling panels			2"

RIGID PIPE INSULATION (SI)			
Service	Operating Temperature Range °C	Pipe Diameter (mm)	Insulation Thickness (mm)
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 & glycol/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
		65 to 150	50

FLEXIBLE INSULATION	
Service	Insulation Thickness
Horizontal storm and sanitary drainage	25mm
Radiant ceiling panels	50mm

- .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.
- .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 HIGH TEMPERATURE PIPE INSULATION

- .1 Applications: cut or mitre insulation where necessary to fit the shape and contour of the vessel. Impale insulation over welded pins on 12" (300 mm) centres. (When 2 layers are used the joints shall be stagger.) Apply Expanded Metal Lath using speed washers to hold insulation and mesh in place. Lace Metal Edges that butt together with 16 ga. (1.7 mm) galvanized annealed wire.
- .2 Emergency Generator Exhaust
 - .1 Insulate the exhaust stack system including silencer (muffler) with 3" (75 mm) of high temperature pipe insulation.
 - .2 Tightly butt and stagger all joints. Secure blocks with galvanized steel bands. Provide welded

- studs, clips or angles as required to anchor wire and bands. Secure a 1" (25 mm) hexagonal wire mesh over the insulation.
- .3 In exposed areas, cover insulation with 2 coats of Manson No. 375 finishing cement applied in 1/4" (7 mm) layers and trowel to a smooth hard finish.
 - .4 Cover with:
 - .1 6 oz./sq.yd. (200 g/m²) canvas neatly pasted in place.
 - .2 Aluminum jacketing installed to manufacturer's instructions.
 - .5 Insulation shall be extended up through roof sleeve.

3.5 HIGH TEMPERATURE PIPE INSULATION-EMERGENCY GENERATOR

- .1 Removeable Insulation Blankets: Firwin 1200. Typically constructed in 3 layers.

Layers	Material	Temperature Limit	Function
Outer	Silicone Impregnated	Grey: 500°F (260°C)	Protective Coating
	Fiberglass	Red: 600°F (316°C)	
	Aluminized Fiberglass	500°F (260°C) Coating	
		1000°F (538°C) Fabric	
Middle	Fiberglass	Firwin 1200: 1200°F (649°C)	Insulation Media
	CMS Wool	Firwin 1800: 1800°F (982°C)	
Inner	Stainless Steel Mesh	Firwin 304SS: 1800°F (982°C)	Contains Insulation Media
		Firwin 309SS: 1800°F (982°C)	

- .1 Certain applications may require alternative construction methods-ie: an extra layer may be added as in the case of sound or fluid barriers.
- .2 Aluminum coating may separate from fiberglass fabric at 500°F (260°C), but fabric maintains good strength until 1000°F (538°C)
- .3 1" insulation suffices for most applications; however, thickness can be varied based on particular application requirements.
- .4 The stainless-steel inner liner may be replaced by a fiber-containing material in cases where fiber containment is a requirement.
- .5 Removeable insulation blankets are wrapped around the part of the insulated generator exhaust system. The blankets are fastened in place using lacing wire. Other fastening options do not exist including snaps, straps, springs, and Velcro.
- .6 Extend up through roof sleeve.
- .2 Other manufacturers: Wrapex, TNL.

3.6 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 as follows: 1/2" (13 mm) thick for pipe 1" (25 mm) O.D. and smaller; 3/4" (20 mm) thick for pipe 1-1/8" (28 mm) to 2" (50 mm) O.D.; 1" (25 mm) thick for pipes 2-1/8" (54 mm) O.D. and larger. . Thickness shall be minimum 1" thick for refrigerant lines running at the exterior or the building. Interior refrigerant piping shall be insulated end to end with 1/2" closed cell pipe insulation for piping up to 1" in diameter or 3/4" 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 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 Cabinets
- .3 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 Badger
 - .3 Strike

.4 Wilson&Cousins

2.2 MULTI-PURPOSE DRY CHEMICAL (FEX)

- .1 Type: multi-purpose (ABC) type, dry chemical
- .2 Size: 5 lb. (2.27 kg)
- .3 Rating: minimum 3A:10BC.
- .4 Badger model ADV-550

OR

- .1 Type: multi-purpose (ABC) type, dry chemical
- .2 Size: 10 lb. (4.54 kg)
- .3 Rating: minimum 4A:60BC
- .4 Badger model ADV-10

2.3 CARBON DIOXIDE (FEX-CO2)

- .1 Type: carbon dioxide type
- .2 Size: 10 lb. (4.54 kg)
- .3 Rating: minimum 5BC.
- .4 Badger model B10V-1

2.4 CABINETS

- .1 Fully Recessed
 - .1 Tub: 18 ga. (1.3 mm) steel tub with white prime painted finish
 - .2 Door & Trim: 14 gauge (2.1 mm) stainless steel, brushed finish OR steel with prime painted finish
 - .3 Panel: "Lexan" glass
 - .4 Size: to accommodate specified extinguisher
- .2 Fully Recessed (5lbs ABC FEX)
 - .1 203mm x 432mm x 127mm (8" x 17" x 5") recessed fire extinguisher cabinet constructed of 22 ga. (.76mm) steel tub and 16 ga. (1.57mm) steel door & trim with ¼" (6mm) return frame, a full length semi-concealed piano hinge and flush stainless steel door latch.
 - .2 Minimum wall depth 127mm (5").
 - .3 Entire cabinet finished in baked enamel paint and glazed with 3 /16" (5mm) clear glass
 - .4 Maximum 5lbs Dry Chemical Extinguisher
 - .5 National Fire Equipment model 102F
 - .6 Locate Multi-Purpose Dry Chemical Extinguisher (FEX) in cabinet, unless noted otherwise.
- .3 Fully Recessed (10lbs ABC FEX)
 - .1 (9" X 24" X 6") recessed fire extinguisher cabinet constructed of 22 ga. (.76mm) steel tub and 16 ga. (1.57mm) steel door & trim with 1/4" (6mm) return frame, a full length semi-concealed piano hinge and flush stainless steel door latch.
 - .2 Entire cabinet finished in baked enamel paint and glazed with 3 /16" (5mm) clear glass
 - .3 National Fire Equipment model CE-950-3
 - .4 Locate Multi-Purpose Dry Chemical Extinguisher (FEX) in cabinet, unless noted otherwise.

2.5 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 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 System design, installation, and certification.
- .2 Wet-pipe sprinkler assembly.
- .3 Dry-pipe sprinkler assembly.
- .4 Pre-action sprinkler assembly.
- .5 Fire department connections.

1.4 REFERENCES

- .1 NFPA 13 - Installation of Sprinkler Systems
- .2 NFPA 13A - Inspection, Testing and Maintenance of Sprinkler Systems
- .3 NFPA 15 - Water Spray Fixed Systems
- .4 NFPA 16 - Installation of Deluge Foam-Water Sprinkler System and Foam-Water Spray Systems
- .5 NFPA 16A - Installation of Closed-Head Foam-Water Sprinkler Systems
- .6 NFPA 25 - Water Based Fire Protection Systems
- .7 NFPA 26 - Supervision of Valves Controlling Water Supplies
- .8 NFPA 72 - Installation, Maintenance and Use of Protective Signalling Systems
- .9 NFPA 72E - Automatic Fire Detectors
- .10 NFPA 72G - Installation, Maintenance and Use of Notification Appliances for Protective Signalling Systems
- .11 NFPA 72H - Testing Procedures for Local, Auxiliary, Remote Station and Proprietary Protective Signalling Systems
- .12 NFPA 75 - Protection of Electronic Computer/Data Processing Equipment
- .13 NFPA 231 - General Storage
- .14 NFPA 231C - Rack Storage of Materials
- .15 NFPA 291 - Fire Flow Testing and Marking of Hydrants
- .16 FM - Factory Mutual Approval Guide.
- .17 ULC/ORD C263.1 Sprinkler-Protected Windows Systems
- .18 ULC - Fire Resistance Directory.
- .19 UL 199 - Automatic Sprinklers for Fire-Protection Service.

1.5 SYSTEM DESCRIPTION

- .1 System to provide coverage for entire building (renovated area).
- .2 Provide system to Owner's Insurer's occupancy requirements.
- .3 Determine volume and pressure of incoming water supply from water flow test data.
- .4 Interface system with building fire alarm system.
- .5 Provide fire department connections where indicated.
- .6 Dual system Clean agent with preaction system
 - .1 Supply and install a self-contained Preaction system with clean agent system. Engineered Novec™ 1230 type as indicated, including:
 - .1 Integrated cabinet
 - .2 Clean agent suppression system
 - .3 Preaction Double Interlock
 - .4 Dual agent Releasing Control Panel
 - .2 The integrated unit shall include an FM Approved SEVO clean agent system in a cabinet

- enclosure.
- .3 Extinguishing agent shall be Novec 1230, Dodecafluoro-2-methylpentan-3-one.

1.6 CLEAN AGENT DESIGN REQUIREMENTS

- .1 The NOVEC™ 1230 system shall be a 500psi Engineered type system. It shall have a minimum design of 4.2% volumetric concentration for Class A hazard and a minimum of 5.85% volumetric concentration for Class B hazard, minimum concentration for Class C hazard shall be at least that for Class A surface fire, at the minimum anticipated temperature with the protected area.
- .2 System design shall not exceed 10% for normally occupied spaces, adjusted for maximum space temperature anticipated altitude and with provisions for room evacuation before agent release.
- .3 System shall provide total flooding Novec™ 1230 concentration in maximum 10 seconds for a 10 minutes holding time.

1.7 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide data on following components including manufacturers catalogue information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- .1 sprinkler alarm valves
 - .2 flow switches
 - .3 water motor alarm
 - .4 excess pressure pump
 - .5 siamese pumper connection
 - .6 low pressure alarm switch
 - .7 ball drain valve
 - .8 air compressor
 - .9 sprinkler heads
 - .10 shut-off valves
 - .11 window sprinkler system
- .2 Preliminary layout: show finished ceiling areas indicating sprinkler locations coordinated with ceiling installation.
- .3 Hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories, indicating:
- .1 Sheet number.
 - .2 Sprinkler description and discharge constant K.
 - .3 Hydraulic reference points.
 - .4 Flow l/s.
 - .5 Pipe size.
 - .6 Pipe lengths, centre to centre of fittings.
 - .7 Equivalent pipe lengths for fitting and devices.
 - .8 Friction loss in kPa at each reference point.
 - .9 Total friction loss between reference points.
 - .10 Elevation head in kPa at each reference point.
 - .11 Required pressure in kPa at each reference point.
 - .12 Velocity pressure and normal pressure if included in calculations.
 - .13 Notes to indicate starting points, reference to other sheets or to clarify data shown.
 - .14 Semi-logarithmic graph paper indicating water supply curves and systems requirements plus inside and outside hose requirements so as to present a graphic summary of complete hydraulic calculations.
- .4 Layout and Installation Drawings: Clearly indicate:
- .1 Name and department or agency
 - .2 Location, including street address.
 - .3 Point of compass
 - .4 Ceiling construction.
 - .5 Full height cross section.
 - .6 Location of fire walls.
 - .7 Occupancy of each area or room.

- .8 Location and size of blind spaces and closets.
- .9 Any questionable small enclosures in which no sprinklers are to be installed.
- .10 Size of city main in street, pressure and whether dead-end or circulating and if dead-end, direction and distance to nearest circulating main, with city main test results.
- .11 Other sources of water supply, with pressure or elevation.
- .12 Make, type and orifice size of sprinklers.
- .13 Temperature rating and location of high temperature sprinklers.
- .14 Number of sprinklers on each riser and on each zone by floors, and total area protected by each zone on each floor.
- .15 Number of sprinklers on each riser and total per floor.
- .16 Make, type, model and size of alarm valves.
- .17 Arrangement and operation of system controls.
- .18 Kind and location of alarm bells.
- .19 Cutting lengths of pipe or centre to centre dimensions.
- .20 Crosses, riser nipples and sizes.
- .21 Type of hangers, inserts and sleeves.
- .22 All control valves, checks, drain pipes and test pipes.
- .23 Small hand hose and hose equipment.
- .24 When plans include underground pipe indicate: weight or class and size of pipe pits; depth of top of pipe below grade.
- .25 Provisions for flushing.
- .26 Name and address of contractor
- .27 A summary sheet, clearly indicating:
 - .1 Date.
 - .2 Location.
 - .3 Name of department of agency.
 - .4 Building number or other identification.
 - .5 Description of hazard.
 - .6 Name and address of contractor or designer.
 - .7 Name of approving agency.
 - .8 System design requirements, including design area of water application, minimum rate of application and area per sprinkler.
 - .9 Total water requirements as calculated including allowance for inside hose and outside hydrants.
 - .10 Water supply information.
- .5 Submit shop drawings to Owner's insurance underwriter and authorities having jurisdiction for approval. Submit proof of approval to Consultant.
- .6 Samples: Submit two of each style of sprinkler specified.

1.8 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- .2 Contractor's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- .3 Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
 - .1 Dual clean agent and preaction system:
 - .1 This manual must include all necessary instructions to operate and maintain the system, and be explicit regarding the interaction between the clean agent suppression system (Novec™ 1230) and the controls and detection portion. Emergency procedures must form an integral part of the manual.
 - .2 Supply separate user manuals specific to the release control panel.
- .4 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.9 QUALITY ASSURANCE

- .1 Perform Work to OBC, NFPA 13 and Owner's Insurer's (FM Global) requirements. Maintain one copy on site.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience.
- .4 Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed at the place where the Project is located.

1.10 REGULATORY REQUIREMENTS

- .1 Conform to OBC, OFC, ULC, FM Global.
- .2 Sprinkler Systems: Conform to NFPA 13, FM Global.
- .3 Valves: Bear FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- .4 Equipment and Components: Bear ULC and FM label or marking.
- .5 Products Requiring Electrical Connection: CSA Listed and classified by Underwriters Laboratories of Canada Inc., as suitable for the purpose specified and indicated.

1.11 DELIVERY, STORAGE, AND PROTECTION

- .1 Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.12 EXTRA MATERIALS

- .1 Provide extra sprinklers to NFPA 13.
- .2 Provide suitable wrenches for each sprinkler type.
- .3 Provide metal storage cabinet located adjacent to alarm valve.
- .4 Provide two of valve stem packings for each size and type of valve installed.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 General
 - .1 Viking.
 - .2 Reliable.
 - .3 Tyco
 - .4 Victaulic
- .2 Dual clean agent and preaction system
 - .1 Fireflex System Inc.

2.2 SPRINKLERS

- .1 Suspended Ceiling:
 - .1 Type: Semi-recessed pendant type with matching push on escutcheon plate.
 - .2 Finish: Chrome plated.
 - .3 Escutcheon Plate Finish: Chrome plated.
 - .4 Fusible Link: Glass bulb type temperature rated for specific area hazard.
- .2 Exposed Area Type:
 - .1 Type: Standard upright type with guard.
 - .2 Finish: Brass.
 - .3 Fusible Link: Glass bulb type temperature rated for specific area hazard.
- .3 Sidewall Type:
 - .1 Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate and

- guard.
- .2 Finish: Chrome plated.
- .3 Escutcheon Plate Finish: Chrome plated.
- .4 Fusible Link: Glass bulb type temperature rated for specific area hazard.
- .4 Dry Sprinklers:
 - .1 Type: Standard pendant type with matching push on escutcheon plate.
 - .2 Finish: Brass.
 - .3 Escutcheon Plate Finish: Brass.
 - .4 Fusible Link: Glass bulb type temperature rated for specific area hazard.
- .5 Concealed Pendant:
 - .1 Cover plate attachment with 1/2" (13mm) assembly adjustment.
 - .2 Smooth aesthetic ceiling profile.
 - .3 Factory installed protective cap.
 - .4 Factory painted (confirm colour with architect prior to ordering)
- .6 Guards: Finish to match sprinkler finish.
- .7 Pendent sprinklers and sidewall pendent sprinklers shall be installed on return bends.
- .8 Horizontal sidewall sprinklers shall be installed so that water is not trapped.
- .9 Sprinkler temperature rating to be Ordinary 160°F (70°C). For sprinklers in locations with Intermediate rating provide 212°F (100°C) rated heads.

2.3 PIPING SPECIALTIES

- .1 Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.
- .2 Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve
- .3 Pre-action Sprinkler System: factory assembled and tested Viking "Total Pac" or equivalent, double interlocked, supervised preaction system using a deluge valve controlled by an electric release system including the following components:
 - .1 Deluge valve
 - .2 Check valve with rubber seat
 - .3 Main water supply control valve with tamper switch
 - .4 Sprinkler system piping network
 - .5 Strainer orifice check valve (S.O.C.V.)
 - .6 Test drain valve
 - .7 Drip check valve
 - .8 Check valve
 - .9 Strainer
 - .10 Alarm test valve
 - .11 Manual emergency release
 - .12 Gauge valve
 - .13 Water inlet pressure gauge (0-300 PSI)
 - .14 Priming chamber pressure gauge (0-300 PSI)
 - .15 System air pressure gauge (air, 0-80 PSI) (delay 80-250 PSI)
 - .16 Priming valve
 - .17 Solenoid valve (N.C.)
 - .18 Pressure operated relief valve (P.O.R.V.)
 - .19 Low air pressure supervisory switch
 - .20 Alarm pressure switch
 - .21 Main drain valve
 - .22 Electric junction with terminals
 - .23 Release control panel
 - .24 Air supply - air compressor with air maintenance device
 - .25 Steel enclosure cabinet
 - .26 Water inlet header including couplings

- .27 Water drain header including couplings
- .28 90 Degree grooved elbow including couplings
- .29 Grooved end system riser stub including couplings
- .4 Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.
- .5 Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
- .6 Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- .7 Fire Department Connections:
 - .1 Type: Flush mounted wall type with chrome plated finish.
 - .2 Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
 - .3 Drain: 3/4" (19 mm) automatic drip, outside.
 - .4 Label: "Sprinkler - Fire Department Connection".
- .8 Supervisory Switches: As manufactured by Potter.

2.4 DOUBLE CHECK BACKFLOW PREVENTERS

- .1 Manufacturer: Watts Model 757BFG
 - .1 Febco
 - .2 Zurn
 - .3 Conbraco
- .2 Type: 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. UL/FM grooved gear operated butterfly valves with tamper switch.

2.5 DRY VALVE AND TRIM

- .1 The fire sprinkler system installed in areas with temperatures that cannot be reliably maintained above 40°F shall be a dry pipe system. The system shall be installed in conformance with the current Edition of N.F.P.A. 13, Standard for Installation of Sprinkler Systems. All materials installed shall adhere to the manufacturer's installation guidelines.
- .2 Dry Pipe Valve:

All dry pipe systems shall be equipped with a dry pipe valve. The dry pipe valve shall be a positive latching clapper, differential type dry valve. Dry valve shall be UL Listed and Factory Mutual Approved. Air pressure to water pressure area differential to be approximately 6 to 1. Dry pipe valve trim shall be galvanized. Dry Pipe Valve manufacturer to be The Viking Corporation. The Dry Pipe Valve to be Viking Model F- 1.
- .3 System Control Valve:

The dry system control valve shall be a listed indicating type valve. The control valve shall be UL Listed and Factory Mutual Approved for fire protection installations. The system control valve shall be rated for normal working pressure but in no case less than 175 PSI.
- .4 Sprinklers:

Refer to Section 2.2 Sprinklers
- .5 Drains:

Where the capacity of trapped sections of piping is less than 5 gallons, an auxiliary drain consisting of not less than a 1/2" valve and plug shall be provided. Where the capacity of trapped sections of piping is more than 5 gallons, a drain consisting of two 1" valves and a 2" by 12" condensate nipple (drum drip) shall be provided.
- .6 Compressed Air Supply:

An air supply capable of restoring system pressure within 30 minutes shall be provided. Riser mounted air compressor listed as an air maintenance compressor.
- .7 Air Compressor:

- Refer to Section 2.7 Air Compressor
- .8 Air Maintenance Device:
Air supplies provided for sprinkler systems shall be equipped with an automatic air pressure maintenance device. Air maintenance device shall be equipped with a ¼" air supply bypass with a field adjustable air pressure regulator with a built-in ball check valve to eliminate air loss when system is in service. Air maintenance device shall have a factory setting of 40 PSI. Air Maintenance Device manufacturer to be The Viking Corporation. Air Maintenance Device to be Viking Model D-2.
- .9 Quick Opening Device:
If water cannot be delivered to the dry system inspectors test connection within a minute of opening, a quick opening device shall be provided on the system riser. The quick opening device shall be of the same manufacturer as the dry pipe valve. The sprinkler system quick opening device shall be an accelerator with an external anti- flooding device. Accelerator manufacturer to be The Viking Corporation. Accelerator to be Viking Model E-1.
- .10 Anti-Flooding Device:
Accelerators installed on sprinkler systems shall be equipped with an external anti-flooding device. Anti-flooding device shall be of a brass body. Anti-flooding device shall be UL Listed and Factory Mutual Approved. Anti-Flooding Device manufacturer to be The Viking Corporation. Anti-Flooding Device to be Viking Model B-1.
- .11 Quick Opening Device:
Where required, the sprinkler system quick opening device shall be a UL Listed and Factory Mutual Approved accelerator with an internal anti-flooding device. Accelerator shall have an air source from a dependable air source regulated through an approved air maintenance device. Accelerator shall be of the same manufacturer as the dry pipe valve or deluge valve and be listed for use together. Accelerator manufacturer to be The Viking Corporation. Accelerator to be Viking Model D-2.
- .12 Pressure Supervisory Switch:
Low air pressure alarm will activate by way of a pressure supervisory alarm pressure switch. The low air pressure alarm switch shall be compatible with system devices. Low air pressure alarm switch enclosure shall be UL Listed and Factory Mutual Approved for the application in which it is used. Low air pressure alarm switch shall have the ability to be wired for Class A or Class B service. Low Air Pressure Alarm Switch shall be Viking, part number 09472 or 09473.
- .13 Alarm Pressure Switch:
Water flow will activate an alarm by way of an alarm pressure switch. The alarm pressure switch shall be compatible with system devices. Alarm pressure enclosure shall be UL Listed and Factory Mutual Approved. Alarm pressure switch shall have the ability to be wired for Class A or Class B service. Alarm Pressure Switch shall be Viking, part number 09470 or 09471.
- .14 System Check Valve:
Check valves shall be UL Listed and Factory Mutual Approved for use on fire protection systems. Check valves shall be constructed of a ductile iron body with a brass seat and a rubber faced clapper assembly hinged to a removable access cover. Check valves shall be equipped with a removable access cover for periodic inspection as required in N.F.P.A. 25, Standard for Inspection, Testing and Maintenance of Water- Based Fire Protection Systems. Check valves shall have a working water pressure of 250 PSI. Check Valve manufacturer to be The Viking Corporation. Check Valve to be Viking Model D-1 or G-1.

2.6 PRESSURE MAINTENANCE PUMP

- .1 Manufacturer: Albany Pump Co.
- .2 Type: Close coupled motor and positive displacement pump unit.
- .3 Construction: Bronze with stainless steel shafts, carbon bearings.
- .4 Motor: Open drip proof, permanently lubricated.
- .5 Electrical Characteristics: CSA listed, ULC and FM approved.
- .1 0.38 kW.
- .2 115 volts,
- .3 single phase,
- .4 60 Hz.
- .6 Accessories: Include flexible hose connections.
- .7 Operation: Manual.

2.7 AIR COMPRESSOR

- .1 Manufacturer: DeVilbiss
- .2 Other acceptable manufacturers: refer to Section 15010 - General Requirements
- .3 CSA listed, ULC and FM approved.
- .4 Floor mounted complete with all necessary piping, accessories and devices.
- .5 Compressor shall be sized to bring system up to pressure within 30 minutes and controlled by manual on-off switch.
- .6 Provide complete with starter.
- .7 Air supply shall be regulated, restricted and maintained automatically.

2.8 ELECTRIC DETECTION SYSTEM

- .1 Supply and install a complete electrical detection system including:
- .2 System tubing, wiring, heat and/or smoke detectors, signaling devices and connections to auxiliary functions.
- .3 Heat and/or smoke detectors can be wired on zones as indicated. Where more than the allowable quantity of detectors are required on a same detection zone, use the recommended 4-wire type detector base for that detector. Spacing and type of detectors shall meet the requirements of the applicable standards and the manufacturer's recommendations for the application protected.
- .4 The detection and alarm indicating devices (24 Vdc bell, horn or strobe) must be compatible with the release control panel.
- .5 A bell or a horn should be installed near the TotalPac2 cabinet.
- .6 Supervisory tamper and pressure switches mounted inside the cabinet by the factory should be wired to two separate zones and provide separate indications for tamper and air supervisory.
- .7 Note: Refer to the applicable compatible device list provided in the panel Installation, Operation & Instruction Manual to determine which compatible initiating and signaling devices model number to use.

2.9 PRE-ACTION CABINET

- .1 Pre-Action Cabinet
 - .1 Supply and install a double interlocked pre-action cabinet with electric-pneumatic release and control panel containing all hydraulic, pneumatic and electrical components required for the control of a pre-action system. The cabinet shall include the following:
 - .1 Self-contained unit (with release control panel) in sturdy free-standing 14 gauge steel cabinet, measuring:
 - .2 71" x 36" x 20" (180 x 91 x 51cm) for 1½", 2" & 3" systems;
 - .3 71" x 46" x 24" (180 x 117 x 61cm) for 4" & 6" systems.
 - .4 Textured rust proof coating, inside and outside, fire red, oven baked polyester powder on phosphate base (powder coated).
 - .5 Two locked access doors to reduce front area required for opening, easily removable without tools to allow easy installation & servicing.
 - .6 Individual access doors for the hydraulic and electrical sections and the emergency release with a neoprene gasket to avoid vibrations.
 - .7 Viking Deluge Valve model E, complete with releasing trim rated at 250 psi and all the necessary accessories. Trim shall include a mechanical latching device to prevent system from resetting in case of loss of power to the release solenoid. Systems provided with solenoid only, without this mechanical latching device, shall not be accepted. Every valve shall be clearly identified as to its operation with arrows indicating all positions to facilitate system operation.
 - .8 Pressure gauges to indicate water supply, priming water and air pressures of the system. Each pressure gauge must be provided with its own shut-off valve and shall be clearly identified on the outside of the cabinet front door.

- .9 Schedule 40 galvanized steel release trim with solenoid valve and every supervisory and alarm device required. Black pipe will not be accepted.
- .10 Schedule 40 steel pipe header painted fire red, with grooved ends to be connected to supply water from either side.
- .11 Schedule 40 steel pipe drain manifold of 2" diameter painted fire red, with grooved ends for drain connections from either side.
- .12 Properly identified test ports factory mounted into the trim piping to facilitate system testing and commissioning.
- .13 Viking VFR-400 integrated control panel with emergency batteries, in a top mounted enclosure its own access door and a spare sprinklers storage rack (see art. 2.3 for details).
- .14 Field wiring terminal strips integrated with the cabinet for connection of field wiring for auxiliary contacts and power supply for the optional air compressor (see art. 2.3.4 for details).
- .2 The cabinet assembly must be pre-assembled, pre-wired and factory tested under ISO-9001 conditions, as a Viking TotalPac2 System, by FireFlex Systems Inc. It shall also be cULus Listed and FM Approved as an assembled unit.
- .3 Provide a Listed and Approved isolation butterfly valve installed on the system riser inside the cabinet for full flow test purposes. The valve shall be supervised by the same supervisory circuit as the system main water supply valve tamper and wired at the factory. An integrated sight glass shall be part of this arrangement for visually confirming water flow through the main drain upon system actuation. A detailed instructions placard must be provided inside the cabinet door for easy reference.
- .2 Integrated Control Panel
 - .1 The release control panel must be fully integrated to the TotalPac2 cabinet and installed in his own enclosure, mounted at the factory on top of the trim enclosure. Standard wall enclosure normally provided with control panels shall not be used and this arrangement shall be fully Listed & Approved as part of the integrated unit. Panels provided with their regular wall mounted enclosure fitted in the front door of the cabinet will not be considered as fully integrated and shall not be acceptable.
 - .2 The control panel shall be FM Approved and cULus listed to the new UL 864-9 standard. Panel shall include four programmable Class B, Style B initiating zones, two class B supervisory zones, and four programmable output circuits. Onboard, menu-driven programming with twelve pre-installed programs for ease of set-up must also be provided. The panel must be compatible with many different initiating devices including linear heat detection, smoke and heat detectors, water flow indicators, low air pressure switches, and manual pull stations.
 - .3 The control panel should include both an LCD Annunciator describing all system conditions (16 characters on 2 lines) and a set of yellow & red LED lamps identifying each separate alarm and trouble conditions. Easy to operate control buttons shall also be included for the operation of the panel various functions.
 - .4 The control panel should be pre-wired at the factory to a set of industrial grade wiring terminals used for power feed, separate from the terminals used to power the optional air compressor. External wiring to field devices (outside the cabinet) should be wired directly to the control panel module by the installing trade.
 - .5 A set of emergency batteries should be provided with the control panel. Batteries should be calculated to provide emergency power for a specific duration after which they shall be able to provide 5 minutes of alarm and activation of the solenoid valve(s).
 - .6 Choose required stand-by duration:
 - .1 5 minutes of alarm after 24 hours stand-by (UL).
- .3 Detection And Signalling Devices
 - .1 Supply and install a complete electrical detection system including:
 - .2 System tubing, wiring, heat and/or smoke detectors, signaling devices and connections to auxiliary functions.

- .3 Heat and/or smoke detectors can be wired on either zones 1 or 2. Where more than the allowable quantity of detectors are required on a same detection zone, use the recommended 4-wire type detector base for that detector. Spacing and type of detectors shall meet the requirements of the applicable standards and the manufacturer's recommendations for the application protected.
 - .4 The detection and alarm indicating devices (24 Vdc bell, horn or strobe) must be compatible with the release control panel.
 - .5 A bell or a horn should be installed near the TotalPac2 cabinet.
 - .6 Supervisory tamper and pressure switches mounted inside the cabinet by the factory should be wired to two separate zones and provide separate indications for tamper and air supervisory.
Note: Refer to the applicable compatible device list provided in the panel Installation, Operation & Instruction Manual to determine which compatible initiating and signaling devices model number to use.
- .4 Air Supply
- .1 The automatic sprinkler piping is supervised by compressed air from a source installed inside the pre-action cabinet.
 - .2 The air supply must be regulated and of the proper size in order to be able to restore normal system air pressure within 30 minutes.
 - .3 Air compressor and supervisory trim (Air Supply Style "A") shall be provided inside the cabinet and its pressure factory adjusted for the selected configuration.
 - .4 If required by the size of the piping network, an accelerator device, Viking Model E-1 shall be factory installed in the air trim with its own pressure gauge and bypass valve, designed to increase the operating speed of the system.
 - .5 For high humidity environments, a dehydrator assembly must be factory installed in the air trim, with bowl guard, supply control and drain valves. Dehydrator shall be Viking manually generated dessicant-type air dryer, the dessicant acting as a moisture indicator by changing color.

2.10 ABOVE GROUND PIPING

- .1 Steel Pipe: ASTM A53; Schedule 10.
 - .1 joined by welding or by roll grooved pipe and fittings:
 - .1 schedule 10 for sizes 5" (125mm) and smaller,
 - .2 0.134" (3.40mm) for 6" (150mm) diameter,
 - .3 0.188" (4.78mm) for 8" and 10" (200mm and 250mm) diameter.
 - .2 joined with threaded fittings or cut groove pipe and fittings:
 - .1 schedule 40 for sizes 6" (150mm) diameter and smaller,
 - .2 schedule 30 for sizes 8" (200mm) diameter and larger.
- .2 Pipe Fittings:
 - .1 Steel Fittings: ASME B16.9, wrought steel, buttwelded.
 - .2 Cast Iron Fittings: ASME B16.1, flanges and flanged fittings.
 - .3 Malleable Iron Fittings: ASME B16.3, threaded fittings.
 - .4 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - .5 Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocket and O-ring uniformly compressed into permanent mechanical engagement onto pipe.

2.11 PIPE HANGERS AND SUPPORTS

- .1 Conform to NFPA 13.
- .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 40 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 3-1/4" (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.

2.12 VALVES - GENERAL

- .1 cUL or ULC and FM approved, listed and labelled.
- .2 All valves controlling connections to water supplies shall be listed indicating valves.
- .3 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
- .4 Provide valves of the same manufacturer where possible.
- .5 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.
- .6 All valves supplied for this project shall have a current and valid Canadian Registration Number for the Province of Ontario with TSSA. Suppliers shall provide a copy of the Statutory Declaration for valves, stamped, signed and dated by TSSA as validation of the CRN registration. This shall be included with the shop drawing submittal package.
- .7 Materials:
 - .1 Bronze: ASTM B62 or B61 as applicable
 - .2 Brass: ASTM B283 C3770
 - .3 Cast Iron: ASTM A126 Class B
- .8 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
- .9 Design and Testing:
 - .1 Bronze Gate & Check valves: MSS-SP-80
 - .2 Cast Iron Gate Valves: MSS-SP-70
 - .3 Cast Iron Globe Valves: MSS-SP-85
 - .4 Cast Iron Check: MSS-SP-71
 - .5 Butterfly Valves: MSS-SP-67
- .10 Acceptable manufacturers:
 - .1 Kitz
 - .2 Crane, Jenkins.
 - .3 Conbraco.
 - .4 Nibco

2.13 ISOLATION VALVES

- .1 Electrically Supervised: ULC listed, FM approved, NO/NC SPDT dry contact switch suitable for electrical supervision on trouble circuit of facility fire alarm system. Valve monitoring switches shall be Potter Electric Signal and Manufacturing Limited or equivalent.
- .2 Up to 2" (50 mm):
 - .1 Construction: ULC listed, FM approved, 300 psig non-shock WOG, ASTM B62 bronze body, solid wedge disc, rising stem, bronze trim, threaded ends, Kitz #25
- .3 2-1/2" (65 mm) and Larger:
 - .1 Construction: ULC listed, FM approved, 175 psi 1210 kPa CWP, outside screw and yoke, cast iron body, stem with ACME double threads, tapered solid wedge disc, flanged ends, renewable bronze seat rings.

2.14 CHECK VALVES

- .1 2-1/2" (65 mm) and Larger:
 - .1 Construction: ULC listed, FM approved, 175psi (1210 kPa)CWP, iron body and bolted cap, bronze trim, bronze swing disc with replaceable bronze seat rings, flanged ends.
- OR
- .2 Construction: ULC listed, FM approved, 175 psi (1210 kPa), Cast Iron body, 316 stainless steel shaft, Double Door Bronze Disc to B-62, Buna seat, 316 stainless steel spring, wafer

style.

2.15 DRAIN VALVES

- .1 Construction: ULC listed and FM approved, brass ball valve with cap and chain, 3/4" (20 mm) hose thread.

3 EXECUTION

3.1 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs.
- .2 Remove scale and foreign material, from inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

3.2 PIPING INSTALLATION

- .1 Install piping to NFPA 13 for sprinkler systems,
- .2 Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- .3 Install piping to conserve building space, to not interfere with use of space and other work.
- .4 Group piping whenever practical at common elevations.
- .5 Sleeve pipes passing through partitions, walls, and floors.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .7 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 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.
- .8 Pipe Hangers and Supports:
 - .1 Install to NFPA 13.
 - .2 Install hangers to provide minimum 1/2" (15 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" (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - .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.
- .9 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- .10 Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding, maximum VOC content of 250 g/L.
- .11 Do not penetrate building structural members unless indicated.
- .12 Provide sleeves when penetrating footings. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- .13 When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- .14 Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- .15 Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to

- installation.
- .16 Provide ball valves for shut-off or isolating service.
- .17 Provide drain valves at main shut-off valves, low points of piping and apparatus.
- .18 All control, drain and test connection valves shall be provided with permanently engraved and marked weatherproof metal or rigid plastic identification signs, secured with weather resistant chain or other approved method.

3.3 SPRINKLER EQUIPMENT INSTALLATION

- .1 Install to NFPA 13.
- .2 Install equipment to manufacturer's instructions.
- .3 Provide approved reduced pressure principle backflow preventer assembly at sprinkler system water source connection.
- .4 Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- .5 Place pipe runs to minimize obstruction to other work.
- .6 Place piping in concealed spaces above finished ceilings.
- .7 Centre sprinklers in two directions in ceiling tile and provide piping offsets as required.
- .8 Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- .9 Install air compressor on vibration isolators. Refer to Section 23 05 48.
- .10 Flush entire piping system of foreign matter.
- .11 Install guards on sprinklers where indicated.
- .12 Hydrostatically test entire system (renovated sprinkler zone).
- .13 Require test be witnessed by Fire Marshall (Owner's Fire Safety Officer).

3.4 INTERFACE WITH OTHER PRODUCTS

- .1 Ensure required devices are installed and connected as required to fire alarm system.

3.5 OPERATING SEQUENCE FOR WET SPRINKLERS

- .1 In Normal Set Condition: The system piping is filled with water.
 - .1 All water supply control valves open and secured.
 - .2 Alarm test shut-off valve in "ALARM" position.
 - .3 Water gauge valves open.
 - .4 The water supply pressure gauge (lower gauge) equals that of the known service-line pressure. The system pressure gauge (upper gauge) reading is equal to or greater than the water supply pressure gauge reading.
 - .5 Incoming power to all alarm switches on.
 - .6 Main-drain valve, auxiliary drain valves and inspectors test valves tightly closed.
 - .7 The sprinkler head cabinet contains appropriate replacement sprinklers and wrenches.
 - .8 Temperature maintained above freezing for entire system.
 - .9 If Fire Department connection is used, make sure the automatic drip valve is free allowing accumulated water to escape.
 - .10 Sprinklers in good condition and unobstructed.
- .2 In Fire Condition:
 - .1 The heat produced operates a sprinkler allowing the water to flow.
 - .2 The alarm valve clapper is opened by the flow of water allowing pressurized water to enter the alarm port to activate the connected alarm devices.
 - .3 When using variable pressure trim the water flowing through the alarm port overcomes the retarding chamber's drain restriction, filling the retarding chamber then activating the connected alarm devices.
 - .4 The alarms will continue to sound until the flow of water is manually turned off.
- .3 In Service condition:
 - .1 The system should be placed out of service only for repairs.
 - .2 The work to be done must be completed in a manner to minimize the time that the system must be out of service.

- .3 All hazardous activities in the effected area shall be terminated until the system is placed back in service.
- .4 Any system impairment shall be coordinated with the Owner, local authority having jurisdiction and other related parties.
- .5 Provide a roving fire patrol in the area covered by the system until the system is back in service.
- .6 Prior to turning off any valves or activating any alarms, notify local security guards and/or central alarm station so that a false alarm will not be signalled and result in a local fire department response.

3.6 OPERATING SEQUENCE FOR DRY SPRINKLERS

- .1 In Normal condition:
 - .1 The system up to dry valve is filled with water, upstream from dry valve with media.
 - .2 All control valves open, locked and sealed with tamper proof seals.
 - .3 ALARM TEST SHUT-OFF VALVE IN "ALARM" POSITION.
 - .4 Water and air pressure gauge valves open.
 - .5 Accelerator shut-off valves open.
 - .6 System air-pressure and accelerator gauges indicating equal pressure.
 - .7 The water-pressure-gauge reading equals that of the known service-line pressure.
 - .8 Incoming power to all alarm switches on.
 - .9 Test drain valve, auxiliary-drain valves and inspector's test valves should be tightly closed.
 - .10 If an automatic air supply is used: the compressor should be on the air-maintenance-device; the by-pass valve should be closed; and, the system air should be maintained at a constant pressure.
 - .11 The sprinkler head cabinet contains appropriate replacement sprinklers.
 - .12 Dry valve house temperature should be maintained above freezing.
 - .13 Drum drips and low points should be free of water.
 - .14 The water level in the riser must be below the air supply drain.
- .2 In Fire condition:
 - .1 The heat produced will operate a sprinkler causing the air pressure in the piping system to escape.
 - .2 When the pressure trip-point is reached, the dry pipe valve opens allowing water to flow through the system piping and to the water motor alarm or electric pressure switch to sound an electric alarm.
 - .3 The alarms will continue to sound until the system is manually shut-off.
- .3 In Service condition:
 - .1 The system should be placed out of service only for repairs.
 - .2 The work to be done must be completed in a manner to minimize the time that the system must be out of service.
 - .3 All hazardous activities in the effected area shall be terminated until the system is placed back in service.
 - .4 Any system impairment shall be coordinated with the owner, local authority having jurisdiction and other related parties.
 - .5 Provide a roving fire patrol in the area covered by the system until the system is back in service.
 - .6 Prior to turning off any valves or activating any alarms, notify local security guards and/or central alarm station (if used) so that a false alarm will not be signalled and result in a local fire department response.

3.7 OPERATING SEQUENCE FOR PRE-ACTION SPRINKLERS

- .1 In Normal condition:
 - .1 The pre-action system shall be a double interlocked arrangement utilizing a deluge valve, pneumatic supervision of the automatic sprinkler system, and an electric detection system.
 - .2 System water supply pressure enters the priming chamber of the deluge valve through the 1/4" (8 mm) priming valve, strainer, restricted orifice and check valve.

- .3 The water supply pressure is trapped in the priming chamber holds the deluge valve clapper closed, keeping the outlet chamber and system piping dry.
- .4 The deluge valve release trim utilizes a normally closed electric solenoid valve controlled by an approved system control panel with two initiating circuits configured for "crosszoned" operation.
- .5 One initiating circuit is connected to the electric detection system; the other to a "low air" supervisory switch.
- .6 The electric detection system is also "crosszoned" such that two (2) sensing devices must be activated to initiate an alarm condition.
- .7 If the electric detection system (alone) operates due to fire, damage or malfunction, and alarm will activate but the deluge valve will not open.
- .8 If the sprinkler piping is damaged or a sprinkler is broken or fused, but the detection system has not activated, and alarm will activate but the deluge valve will not open.
- .9 All control valves open, locked and sealed with tamper proof seals.
- .10 Water and air pressure gauge valves open.
- .11 System air-pressure and accelerator gauges indicating equal pressure.
- .12 The water-pressure-gauge reading equals that of the known service-line pressure.
- .13 Incoming power to all alarm switches on.
- .14 Test drain valve, auxiliary-drain valves and inspector's test valves should be tightly closed.
- .15 Automatic air supply compressor on the air-maintenance-device; the by-pass valve should be closed; and, the system air should be maintained at a constant pressure.
- .16 The water level in the riser must be below the air supply drain.
- .2 In Set condition:
 - .1 The water supply pressure is trapped in the priming chamber by check valve and normally closed solenoid valve.
- .3 In Fire condition:
 - .1 Operation of the detection system activates the first initiating circuit in the system control panel causing an alarm to activate.
 - .2 When a sprinkler operates, supervisory pressure escapes from the sprinkler piping.
 - .3 Air supervisory switch activates the second initiating circuit in system control panel.
 - .4 When both initiating circuits have been activated, system control panel energizes solenoid valve open.
 - .5 Pressure is released from the priming chamber to open drain cup faster than it is supplied through restricted orifice.
 - .6 The deluge valve clapper opens to allow water to flow into the system piping and alarm devices, causing water motor alarm and water flow alarms connected to alarm pressure switch to activate.
 - .7 An accelerator must be installed when necessary to provide earlier alarms and/or allow the system to fill with water faster to meet system discharge time requirements.
 - .8 When the deluge valve operates, the sensing end of PORV is pressurized, causing the PORV to operate.
 - .9 When the PORV operates it continually vents the priming chamber to prevent the deluge valve from resetting even if solenoid valve closes.
 - .10 The deluge valve can only be reset after the system is taken out of service, and the outlet chamber of the deluge valve and associated trim piping is depressurized and drained.
 - .11 The alarms will continue to sound until the system is manually shut-off.
- .4 In Trouble conditions:
 - .1 If a sprinkler opens prior to operation of the detection system or any time supervisory pressure in the sprinkler piping is lost, alarms connected to air supervisory switch will signal a low air pressure condition but the deluge valve will not open.
 - .2 If the electric detection system (alone) operates due to damage or malfunction, alarms connected to system control panel will activate but the deluge valve will not open.
- .5 Manual Operation:
 - .1 Any time the handle inside emergency release is pulled, pressure is released from the priming chamber; the deluge valve will open.
 - .2 Water will flow into the system piping, and alarm devices.
 - .3 If a sprinkler head open, water will flow from the system.

- .6 In Service condition:
 - .1 The system should be placed out of service only for repairs.
 - .2 The work to be done must be completed in a manner to minimize the time that the system must be out of service.
 - .3 All hazardous activities in the effected area shall be terminated until the system is placed back in service.
 - .4 Any system impairment shall be coordinated with the owner, local authority having jurisdiction and other related parties.
 - .5 Provide a roving fire patrol in the area covered by the system until the system is back in service.
 - .6 Prior to turning off any valves or activating any alarms, notify local security guards and/or central alarm station (if used) so that a false alarm will not be signalled and result in a local fire department response.
- .7 Important Settings:
 - .1 Recommended supervisory pressure in the closed sprinkler piping is 30 PSI (207 kPa). Air supervisory switch (E.3) should be equipped with two sets of independently adjustable contacts.
 - .1 Where supervisory pressure is maintained at 30 PSI (207 kPa), adjust one set of contacts of air supervisory switch to activate at 25 PSI (172 kPa) on pressure drop. These contacts should be wired to activate a "Low air" supervisory alarm.
 - .2 The other set of contacts in air supervisory switch should activate at 20 PSI (138 kPa) on pressure drop. Wire these contacts to activate the remaining initiating circuit of the system control panel configured for "crosszoned" operation. Refer to the appropriate wiring diagram packed with the panel. Activation of an alarm to signal a high pressure condition may be required.
 - .2 Alarm pressure switch should activate when pressurized to 4 to 8 PSI (27 to 55 kPa) on pressure rise and should be wired to activate the water flow alarm.

3.8 TESTING AND INSPECTION

- .1 Test automatic sprinkler in accordance with requirements of NFPA 13 and NFPA 25.
 - .1 hydrostatically tested at 50 psi (3.5 bar) in excess of system working pressure and minimum test pressure of 200 psi (13.8 bar) for 2-hr.
 - .2 When cold weather prevents testing with water, an interim test may be conducted with air. The hydrostatic test with water must be conducted subsequently when conditions permit.
 - .3 Modifications affecting fewer than 20 sprinklers and modifications that can not be isolated shall not require testing in excess of system working pressure. Modifications affecting more than 20 sprinklers shall be isolated and tested at not less than 200 psi (13.8 bar) for 2-hr.
 - .4 Loss shall be determined by a drop in gauge pressure or by visible leakage.
- .2 In addition, test pre-action systems in accordance with the manufacturer's instructions and as follows:
 - .1 Low Air Pressure Alarm Test: Quarterly testing of low air alarms is recommended.
 - .1 To prevent operation of the deluge valve and filling the system with water during the test, do NOT operate the electric detection system during this test. Consider closing the main water supply control valve.
 - .2 Fully open the sprinkler system inspectors test valve to simulate operation of a sprinkler.
 - .3 Verify that low air alarms operate within an acceptable time period and continue without interruption.
 - .4 Close the inspectors test valve.
 - .5 Establish pneumatic supervisory pressure to be maintained.
 - .6 Open the system control panel and press RESET. Alarms should stop. When testing is complete, return the system to service following steps 1 through 9 below. Caution, this procedure applies only when done in steps with "Low Air" alarm testing described above.
 - .1 Verify that the pressure indicated on priming pressure water gauge indicates that the priming chamber is pressurized with system water supply pressure.
 - .2 Depress the plunger of drip check. No water should flow from the drip check

- when the plunger is pushed.
- .3 If the main water supply control valve was NOT closed in step 1, proceed with steps 3 through 9 below. If the main water supply valve was closed in step 1, proceed with step 3 through 9 below.
- .4 Open flow test valve and auxiliary drain.
- .5 Partially open main water supply control valve
- .6 When full flow develops from flow test valve. Close the flow test valve.
- .7 Close auxiliary drain.
- .8 Fully open and secure the main water supply control valve.
- .9 Verify that the alarm shut-off valve is open and that all other valves are in their normal operating position.
- .10 Depress the plunger of drip check. No water should flow from the drip check when the plunger is pushed.
- .2 Full Flow Trip Test: Conduct this test prior to final acceptance and prior to occupancy of the protected space.
 - Caution! Performance of this test will cause the deluge valve to open and the sprinkler system to fill with water.**
 - .1 Follow manufacturer's instructions to take the system out-of-service.
 - .2 To trip the electrically controlled single interlocked preaction system:
 - .1 Notify the authorities having jurisdiction and those in the area affected by the test.
 - .2 Trip the deluge valve:
 - .1 Operate a detector or detectors according to the manufacturer's instructions.
 - .2 Open the sprinkler system inspectors test connection.
 - .3 The deluge valve should open filling the sprinkler system with water.
 - .4 Verify adequate flow from the sprinkler system inspector test valve within an acceptable time period.
 - .3 When trip testing is complete drain the system and follow manufacturer's instructions to return the system to service.
 - .4 Notify the authorities having jurisdiction and those in the affected area affected that testing is complete.
 - .3 Performance of a trip test is recommended annually during warm weather. Consider coordinating this test with operation testing of the detectors.
- .3 Arrange and pay for all reviews and inspections required by:
 - .1 Local Inspection Authority.
 - .2 Owner's Insurance Authority.
- .4 Coordinate testing of automatic sprinkler systems with fire alarm system verification to ensure that all devices are fully tested.

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 and pipe fittings.
- .2 Hangers and supports.
- .3 Labelling and identification.
- .4 Valves.
- .5 Accessories.

1.3 REFERENCES

- .1 CSA B149.1 Natural gas and propane installation code, as adopted.
- .2 ANSI B31.1 - Power Piping.
- .3 ASME SEC IX - Welding and Brazing Qualifications.
- .4 ASME B16.3 - Malleable Iron Threaded Fittings.
- .5 ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
- .6 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .7 NFPA 31 - Installation of Oil-Burning Equipment.

1.4 SUBMITTALS

- .1 Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- .2 Project Record Documents: Record actual locations of piping system, storage tanks, and system components.
- .3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- .4 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- .5 Contractor's material and test certificates.

1.5 QUALITY ASSURANCE

- .1 Welding Materials and Procedures: Conform to ASME Code.
- .2 Welders Certification: To ASME SEC IX.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- .5 Valves: Manufacturer's name and pressure rating marked on valve body.

1.6 REGULATORY REQUIREMENTS

- .1 Conform to CSA B149.1 Natural Gas and Propane installation code
- .2 Conform to ANSI B31.1 for installation of fuel oil piping.
- .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 PROTECTION

- .1 Transport, handle, store, and protect products.
- .2 Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain protection in place until installation.

1.8 EXTRA MATERIALS

- .1 Provide two repacking kits for each size valve.

2 PRODUCTS

2.1 ABOVE GROUND PIPING

- .1 Copper Tubing: ASTM B88, Type K, hard drawn.
 - .1 Fittings: ASME B16.18, cast copper alloy or ASTM B16.22 wrought copper and bronze.
 - .2 Joints: AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.
- .2 Steel Pipe: ASTM A53/A53M Gr. B, ERW or A106 SMLS, schedule 40.
 - .1 Fittings: ASTM B16.3, malleable iron class 150, screwed or flanged or ASTM A234/A234M, wrought carbon steel and alloy steel welding type.
 - .2 Joints: NFPA 30, threaded, flanged or welded to ANSI B31.1.
 - .1 Screwed fittings: pulverized lead paste.
 - .2 Welded fittings: butt-welding fittings to CSA W47.1.
 - .3 Flange gaskets: nonmetallic flat, to ASME B16.5.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A 53/A53M.
- .3 Where piping is installed in ceilings used as return air plenums, provide seamless pipe and welding fittings.
- .4 All piping, indoor and outdoor, to be protected by painting with metal primer and exterior enamel paint. Paint the entire piping system yellow and provide "NATURAL GAS" labels with "GAS PRESSURE" identification at 20ft (6m) intervals.

2.2 PIPE HANGERS AND SUPPORTS

- .1 Conform to NFPA 31.
- .2 Hangers for Pipe Sizes 1" - 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 Vertical Support: Steel riser clamp.
- .7 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .8 Roof support: refer to section 20 05 30 and CSA B149.1
- .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.3 ISOLATION VALVES

- .1 2" (50 mm) and smaller: Class 150, 600 psi (4140 kPa) CWP, Brass Body ASTM 283 C37700, two piece body, Chrome plated Ball and brass stem, full port, virgin PTFE seats, Double O Ring design or Adjustable PTFE packing, blow-out proof stem, Lever Handle.
Kitz 58, MAS B3, Toyo Red & White 5044A (Threaded)
- .2 2-1/2" (65 mm) and 3" (75 mm): Class 150, Carbon Steel A216WCB Body, S.S. Ball and Stem, RPTFE Packing and Gaskets, Lever Handle, Flanged.
Kitz 150 SCTDZM-N (Full Port), Kitz 150 SCTAZM-N (Reduced Port)

2.4 PRESSURE REDUCING VALVES

- .1 Gas Pressure Reducing and Relief Valves: Spring loaded regulator with internal relief valve. Cast iron body, aluminum diaphragm case and orifice. For capacities refer to drawings. Fisher Type 133L or 133H, or approved equal as noted on drawings.

3 EXECUTION

3.1 SERVICE CONNECTIONS

- .1 Provide for new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 34 kPa. Provide regulators on each line serving gravity type appliances, sized to equipment.

3.2 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that excavations are to required grade, dry, and not over-excavated.

3.3 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.

3.4 INSTALLATION

- .1 Install to CSA B149.1 as adopted.
- .2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- .3 Route piping in orderly manner 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 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .7 Provide clearance for installation of insulation and access to valves and fittings.
- .8 Provide flexible pipe connections at the generator.
- .9 Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.
- .10 Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- .11 Install valves with stems upright or horizontal, not inverted.
- .12 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- .13 Arrange for installation of gas meter and piping to main meter from street by gas company. Piping from main meter into building by Division 15. Owner to pay all gas company costs.

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 Cleanouts.
- .5 Hose bibs.
- .6 Hydrants.
- .7 Backflow preventers.
- .8 Water hammer arrestors.
- .9 Thermostatic mixing valves.
- .10 Trap Seal Primers.

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 AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
- .8 PDI WH-201 - Water Hammer Arrestors.

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.

2.2 ROOF DRAINS

- .1 Standard roof with insulation up to 1-1/2" (38 mm): Thick lacquered cast iron deep sump body, flashing clamp ring with integral gravel stop, press to lock linear polyethylene plastic dome strainer, underdeck clamp and water-proofing flange.
 - .1 Watts RD-100-BD-W-1
- .2 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
- .3 Standard roof with insulation up to 1-1/2" (38 mm) thick and meter flow: lacquered cast iron deep sump body, flashing clamp ring with integral gravel stop, dome strainer, aluminum meter flow with 6" (150 mm) high integral parabolic weir, underdeck clamp, water-proofing flange, and extension bearing pan.
 - .1 Watts RD-100-BD-W-1-A
- .4 Standard roof and meter flow: lacquered cast iron deep sump body, flashing clamp ring with integral gravel stop, dome strainer, aluminum meter flow with 6" (150 mm) high integral parabolic weir, underdeck clamp, water-proofing flange, and extension bearing pan.
 - .1 Watts RD-100-BED-W-1-A
- .5 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
- .6 Inverted roof and meter flow: lacquered cast iron deep sump body, underdeck clamp, flashing clamp ring with integral gravel stop, press lock linear polyethylene plastic dome strainer, aluminum meter flow with 6" (150 mm) high integral parabolic weir, and adjustable extension with auxiliary drainage slots and secondary clamp.
 - .1 Watts RD-100-CH-D-A
- .7 Small Area Roof Drain: epoxy coated cast iron small sump roof drain with wide serrated flashing flange, flashing clamp device with integral gravel stop, adjustable cast iron combined extension and bearing pan, and self-locking polyethylene (standard) dome strainer.
 - .1 Watts RD-200-BED
- .8 Connect to copper DWV piping in ceiling space above Operating Rooms.
 - .1 Thaler RD-1C
- .9 Built - Up Roofs
 - .1 Manufacturer: Watts Drainage Model RD100-BED-W-1.
 - .2 Assembly: ANSI A112.21.2.
 - .3 Body: Lacquered cast iron with sump.
 - .4 Strainer: Removable polyethylene dome with vandal proof screws.
 - .5 Accessories: Coordinate with roofing type, refer to Division 7:
 - .1 Membrane flange and membrane clamp with integral gravel stop.
 - .2 Adjustable under deck clamp.
 - .3 Roof sump receiver.
 - .4 Adjustable extension sleeve for roof insulation

2.3 FLOOR DRAINS

- .1 Floor Drains in Finished Areas: lacquered or epoxy coated cast iron body with anchor flange, seepage collection sump, nickel bronze strainer, no hub (MJ) outlet.
 - .1 Floor Drains for Non-Membrane Floors: weepholes, serrated anchor flange, 5" (127 mm heavy duty strainer.

- .2 Watts FD-200
Floor Drains for Membrane Floors: cast iron reversible membrane clamp with primary and secondary weepholes.
- .3 Watts FD-100-C
Adjustable Floor Drain For Non-Membrane Floors: Weepholes, surface membrane clamp to accommodate floor covering.
- .4 Watts FD-200-FC
Adjustable Floor Drain For Membrane Floors: Cast iron reversible membrane clamp with primary and secondary weepholes, surface membrane clamp to accommodate floor covering.
- .5 Watts FD-100-C-FC
Hub Drain For Non-Membrane Floors: weepholes, nickel bronze indirect waste hub 5"(125 mm) dia.
- .6 Watts FD-200-DD
Hub Drain For Membrane Floors: cast iron reversible membrane clamp with primary and secondary weepholes, nickel bronze indirect waste hub 5" (125 mm) dia.
- .7 Watts FD-100-C-DD
Funnel Floor Drain For Non-Membrane Floors: weepholes, 4" x 9" (100 x 225 mm) full opening elongated funnel.
- .8 Watts FD-200-EG
Funnel Floor Drain For Membrane Floors: cast iron reversible membrane clamp with primary and secondary weepholes, 4" x 9" (100 x 225 mm) full opening elongated funnel.
- .9 Watts FD-100-C-EG
Funnel Floor Drain For Non-Membrane Floors: weepholes, 4" x 9" (100 x 225 mm) full opening elongated funnel.
- .10 MIFAB F1100-EG
Funnel Floor Drain For Membrane Floors: cast iron reversible membrane clamp with primary and secondary weepholes, 4" x 9" (100 x 225 mm) full opening elongated funnel.
- .10 MIFAB F1100-C-EG
Funnel Floor Drain For Membrane Floors: cast iron reversible membrane clamp with primary and secondary weepholes, 4" x 9" (100 x 225 mm) full opening elongated funnel.
- .2 Floor Drains in Unfinished Areas and Mechanical Rooms: lacquered or epoxy coated cast iron body, anchor flange, adjustable heavy duty ductile iron grate with baked epoxy finish, seepage collection sump.
 - .1 General: Watts FD-300
 - .2 Funnel Floor Drain: 4" x 9" (100 x 225 mm) full opening epoxy elongated funnel.
 - Watts FD-300-G-50

2.4 TRENCH DRAIN

- .1 General: The surface drainage system shall be ACO Drain K200 complete with gratings secured with 'QuickLok' locking as manufactured by ACO, Inc. or approved equal.
- .2 Materials: The trench system bodies shall be manufactured from polyester polymer concrete with the minimum properties as follows:
 - Compressive strength: 14,000 psi
 - Flexural strength: 4,000 psi
 - Water absorption 0.07%
 - Frost proof YES
 - Salt proof YES
 - Dilute acid and alkali resistant YESThe nominal clear opening shall be 8" (200mm) with overall width of 10.24" (260mm). Pre-cast units shall be manufactured with either an invert slope of 0.5% or with neutral invert and have a wall thickness of at least 0.50" (13mm). Each unit will feature a partial radius in the trench bottom and a male to female interconnecting end profile. Units shall have horizontal cast in anchoring keys on the outside wall to ensure maximum mechanical bond to the surrounding bedding material and pavement surface.
The galvanized steel edge rail will be integrally cast in by the manufacturer to ensure maximum homogeneity between polymer concrete body and edge rail. Each edge rail shall be at least 3/32" (2.5mm) thick.

- .3 Grates: ACO Type 678Q longitudinal ductile iron grate with 'QuickLok' locking as manufactured by ACO, Inc. or similar approved.
Materials: The covers shall be manufactured from ductile iron and have minimum properties as follows:
Independently certified to meet Load Class E to EN 1433 - 135,000 lbs - 2,321 psi
Ductile iron to ASTM A 536-84 - Grade 65-45-12
Intake area of 51.62 sq. in. (390.97 cm²) per half meter of grate
The overall width of 9.41" (239mm) and overall length of 19.69" (500mm).
Slots measure at a maximum of 1.41" (35.9mm) by 0.31" (8mm).
- .4 Catch Basin: ACO Drain K2-902G series
Made from polymer concrete with a cast-in galvanized steel rail.
Materials: Polymer concrete shall have material properties of:
Compressive strength: 14,000 psi
Flexural strength: 3,600 psi
Tensile strength: 1,500 psi
Water absorption: 0.07%
Frost proof: yes
Dilute acid and alkali resistant: yes
B117 salt spray test compliant: yes
The K2-902G series catch basin comprising of top section, quicklok grate, short base and trash bucket shall accept 8" ACO drain trench drain model K200.
The catch basin shall be 19.69" (500mm) in length and 10.31" (262mm) in width. K2-902g catch basin depth is 33.18" (842.7mm).
The complete catch basin and trench drainage system shall be by ACO polymer products, inc.
K2-902G series catch basin shall withstand Loading to proper load class as outlined by EN1433.
Grate shall be held in place with the Quicklok system. Catch basin, trench channel and grate shall be independently certified to meet the specified EN 1433 load class.
- .5 Polypropylene foul air trap (FAT) that fits into front or side of in-line catch basins. The FAT is connected to the MDPE catch basins bottoms by means of Sch 40 female to female PVC couplings available from any plumbing retailer. Catch basin base, coupler and FAT are glued together. 2" removable rubber plug for rodding access.
- .6 Installation: The trench drain system and grates shall be installed in accordance with the manufacturer's installation instructions and recommendations.
- .7 Acceptable Alternate Manufacturer: Zurn, Polydrain, MEA, Watts

2.5 TRAP SEAL PRIMERS

- .1 Electronic Trap Priming Manifold
 - .1 Electronic Trap Seal Primer
PPP Smart-Prime SMP-500-115V
1/2" NPT Male Inlet/1/2" NPT Female Outlet. Delivers 2 ozs. of potable water to four floor drain traps every 24 hours.
Priming assembly consists of: A sub-miniature solenoid valve, with timer, a physical air gap and a 6' electrical cord.
Provide Distribution Units as required to allow priming up to four floor drain traps.
For the 24V (SMP-500-24V) and 220V (SMP-500-220V) options, the power supply cord will require a hard wire installation, as it will not have an outlet connection.
 - .2 Enclosed Electronic Trap Seal Primer System
MIFAB® Series MI-100* (*specify 5 to 35 outlet ports) enclosed electronic trap seal primer system with timer, 1/2" 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.

- .3 Electronic Trap Seal Primer With Air Gap (BAS controlled – no Timer/Control Panel)
MIFAB® Series MI-200, electronic trap seal primer system with copper air gap, plastic manifold with distribution ports (specify -500 for 1/2" or -625 for 5/8" port connections when ordering)., electrical, 1/2" stainless steel solenoid valve and 24" wiring harness. Electrical components to include single point power connection at 120 VAC or 24 VDC. The entire assembly is tested and certified to the ASSE 1044 Standard. 100 p.s.i. operating pressure.
The MI-200 is engineered to connect to the low-voltage building energy management system.
- .4 Electronic Trap Seal Primer With Air Gap, Distribution Unit And Timer/Control Panel
MIFAB® Series MI-300, electronic trap seal primer system with copper air gap, electrical stainless steel body 1/2" solenoid valve, and plastic manifold with distribution ports (specify -500 for 1/2" or -625 for 5/8" port connections when ordering). Electronic components to include single point power connection at 120VAC, 220 VAC or 24VDC, manual override switch, 5 amp breaker, 24 hour timer with relay and adjustable delay. The entire assembly is tested and certified to the ASSE 1044 Standard. 100 p.s.i. operating pressure.

2.6 CLEANOUTS

- .1 Interior Finished Floor Areas:
 - .1 Watts Drainage model CO-100-C-RC
 - .1 Epoxy coated cast iron cleanout with anchor flange, reversible membrane clamp, carpet marker, and adjustable combined access cover and plug with gasket seal.
 - .2 Watts Drainage model CO-200-R
 - .1 coated cast iron floor cleanout with 5"(127) round adjustable gasketed nickel bronze top, removable gas tight gasketed brass cleanout plug, and no hub (standard) outlet.
 - .1 On-grade epoxy coated cast iron floor cleanout with 5"(127) round adjustable gasketed nickel bronze top, removable gas tight gasketed brass cleanout plug, and no hub (standard) outlet.
- .2 Stack Interior Finished Wall Areas:
 - .1 Watts Drainage model CO-460
 - .1 Cast iron stack cleanout with gasketed brass countersunk plug, and no hub connections.
 - .2 Watts Drainage model CO-440-RD
 - .1 Wall cleanout with two-piece expandable cleanout plug, stainless steel access cover, and vandal proof stainless steel screw.
 - .3 Watts Drainage model CO-380-RD
 - .1 Cast iron wall cleanout with gasketed brass countersunk plug, stainless steel access cover, vandal proof stainless steel screw, and no hub connection.
- .3 Interior Unfinished Accessible Areas: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.
- .4 Line Cleanouts: lacquered cast iron Malcom type with cleanout ferrule, 1/2" (13mm) thick epoxy coated gasketed cover.
- .5 Caulking for cleanouts: VOC content not to exceed 250g/L.

2.7 HYDRANTS

- .1 Exterior Wall Hydrant, (NFWH):
 - .1 Watts Drainage model HY-725
 - .2 ANSI/ASSE 1019; non-freeze, self-draining type with polished nickel bronze box and cover for recessed mounting, all bronze head, seat casting and internal working parts, 3/4" (20 mm) hose thread spout, key operated, integral vacuum breaker, galvanized wall casing and hydrant key.
- .2 Interior Wall Hydrant, (WH):
 - .1 Watts Drainage model HY-330
 - .2 ANSI/ASSE 1019; self-draining type with polished nickel bronze box and cover for recessed mounting, all bronze head, seat casting and internal working parts, 3/4" (20 mm) hose thread spout, key operated, integral vacuum breaker, galvanized wall casing and hydrant key.

- .3 Interior Hose BIBB, (HB):
 - .1 Watts Drainage model SC8
 - .2 3/4" (20 mm) cast brass with tamper-proof vacuum breaker, cast iron hand wheel.

2.8 BACKFLOW PREVENTERS

- .1 Spill-Resistant Pressure Vacuum Breaker
Anti-Siphon, Spill-Resistant, Vacuum, bronze body construction, thermoplastic check and float assembly valve, stainless steel springs, tee handles, and a molded diaphragm separating the air inlet from the potable water supply to prevent spillage. Temperature Range: 33°F - 180°F (0.5°C - 75°C) continuous. Maximum Working Pressure: 150psi (10.3 bar). Provide strainer ahead of the backflow preventer to prevent the fouling of the check assembly and resulting spillage from the valve during repressurization.
Watts 008PCQT
- .2 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 LF007S
- .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. Backsiphonage 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.

2.9 WATER HAMMER ARRESTORS

- .1 Watts Drainage Series 05
- .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.

3 EXECUTION

3.1 GENERAL

- .1 Install all products in accordance with the plumbing code and with manufacturer's instructions.

3.2 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 Install floor cleanouts at elevation to accommodate finished floor.
- .5 Cleanouts in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.
- .6 Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.
- .7 Ensure clearance at cleanout for rodding of drainage system.

3.3 FLOOR DRAINS

- .1 Provide floor 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 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.

3.5 WALL HYDRANTS

- .1 Locate wall hydrants where indicated.
- .2 Coordinate installation with general trades.

3.6 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.

3.7 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.

3.8 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 Fire sprinkler systems,
 - .4 Premise isolation,
 - .5 Flush valves,
 - .6 Interior and exterior wall hydrants (hose bibbs).
 - .7 Where require 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.

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.
- .2 Sump Pumps.

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 tapings.
 - .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 of pump seals.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 S. A. Armstrong
- .2 Other acceptable manufacturers offering equivalent products.
 - .1 ITT Bell & Gosset
 - .2 Darling-Duro
 - .3 Grundfos

2.1 DOMESTIC HOT WATER RECIRCULATING PUMP (RP-1)

- .1 Armstrong Astro 220ss 1" flange
- .2 Three Speed Wet Rotor Circulator pump model with stainless steel/lead free bronze/cast iron body and Noryl impeller. The pump shall have a capacity of 3 USgpm against a total head of 2.8 ft Armstrong Series are 120V/single phase/60 Hz and are cETLus listed. Stainless Steel/lead free. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 150 PSI(1034 kPa) maximum working pressure.

2.2 SUBMERSIBLE ELEVATOR SUMP PUMP (EP-1)

- .1 General: CSA and Ontario Hydro Inspection approved. Unit shall include cast iron construction, stainless steel shaft, stainless steel fasteners, non-clog two-vane impeller, carbon and ceramic faced mechanical shaft seals, oil cooled motor, 20' power cord with three conductor PVC jacket, thermal type overload protection with automatic reset.
 - .1 Performance: 50 USGPM at 8ft., 115 volt/1/60 Hz, 1/2 HP
 - .2 Manufacturer Myers Model No. ME45MC-11
- .2 Elevator Pump Controller: Separate pump and control circuit, remote alarm & Sensor unit. Sensor unit for pipe mounting to be ABS construction with stainless steel probe and PVC float. Control panel to have NEMA 1 enclosure and 6' SJT 120 VAC power cord. Controller to have pump on, pump run, high water and high oil indicator lights. Separate Alarm Panel with NEMA 1 enclosure, 9 VDC battery backup with LED alarm indicator, 103db buzzer with auto test/reset. Complete system to be UL and CSA listed as well as compliant with ASME 17.1
 - .1 Manufacturer Myers EPP-ME45MC-11
- .3 Basin: Heavy duty fiberglass basin designed to withstand hydrostatic pressure of 120lbs per cu.ft. max. fluid temp 140F. Basin to have anti-floatation collar, dimensions as per schematic on drawings. Basin to be from same manufacturer as pump package.
- .4 Curb & cover plate: Provide curb ring and cover plate as supplied by pump manufacturer to fit pit size indicated on drawings. Cover plate to be flush mounted complete with air tight gasket. No penetration through lid.

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.
- .9 Provide side-stream filtration system for heating water systems. Install across pump with flow from pump discharge to pump suction from pump tapings.

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 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 Pipe, pipe fittings, valves, and connections for piping systems.
 - .1 Sanitary Drain & Vent
 - .2 Storm Drain
 - .3 Domestic (Potable) Water.
- .2 Disinfection of potable water distribution system.
- .3 Testing and reporting results.

1.4 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 D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings.
- .18 ASTM D2239 - Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- .19 ASTM D2241 - Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- .20 ASTM D2447 - Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
- .21 ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- .22 ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
- .23 ASTM D2661 - Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
- .24 ASTM D2665 - Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- .25 ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .26 ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer, Pipe, and Fittings.
- .27 ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.
- .28 ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- .29 ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .30 ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
- .31 ASTM F679 - Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- .32 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .33 AWWA C110 - Ductile - Iron and Gray - Iron Fittings, 3" - 48" (76 mm - 1219 mm), for Water.
- .34 AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

- .35 AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.
- .36 AWWA C651 - Disinfecting Water Mains.
- .37 AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe (and Fabricated Fittings), 4" - 12" (100 mm - 300 mm), for Water Distribution.
- .38 AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2" - 3" (13 mm - 76 mm) for Water Service.
- .39 AWWA C902 - Polybutylene (PB) Pressure Pipe and Tubing, 1/2" - 3" (13 mm - 76 mm) for Water.
- .40 AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14" - 48" (350 mm - 1200mm).
- .41 CISPI 301 - Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
- .42 CISPI 310 - Joints with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- .43 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- .44 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .45 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- .46 NSF 61 - Drinking Water System Components – Health Effects.
- .47 NSF 372 - Drinking Water System Components – Lead Content.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 20 01 01: Procedures for submittals.
- .2 Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Section 20 01 01: Procedures for submittals.
- .2 Project Record Documents: Record actual locations of valves.

1.7 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.
- .3 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1.8 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.

1.9 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.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install underground piping when bedding is wet or frozen.

1.11 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 ABS Pipe: ASTM D2751 or ASTM F628.
 - .1 Fittings: ABS.
 - .2 Joints: ASTM D2235, solvent weld.
- .4 ABS Pipe: ASTM D2661 or ASTM D2751.
 - .1 Fittings: ABS.
 - .2 Joints: ASTM D2235, solvent weld.
- .5 PVC Pipe: ASTM D2665 or ASTM D3034.
 - .1 Fittings: PVC.
 - .2 Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
- .6 PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
 - .1 Fittings: PVC.
 - .2 Joints: ASTM F477, elastomeric gaskets.
- .7 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 ABS Pipe: ASTM D2680 or ASTM D2751.
 - .1 Fittings: ABS.
 - .2 Joints: ASTM D2235, solvent weld, maximum VOC content of 325 g/L.
- .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.

2.4 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.
- .4 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.

2.5 WATER PIPING, ABOVE GRADE

- .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 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 CONDENSATE DRAIN PIPING

- .1 3/4" (20 mm) and 1" (25 mm) type M copper
- .2 1-1/4" (32 mm) and larger annealed copper tubing, type DWV, to ASTM B306-86
- .3 Soldered, with wrought copper or copper alloy drainage fittings to ANSI B16.29-1980 or cast brass drainage fittings to B158.1-1976.

2.7 FLANGES, UNIONS, AND COUPLINGS

- .1 Pipe Size 3/4" (20 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.

2.8 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 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
 - .5 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.
 - .6 Wall Support for Pipe Sizes to 3-1/4" (80 mm): Cast iron hook.
 - .7 Vertical Support: Steel riser clamp.
 - .8 Floor Support for Cold Pipe: 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.

2.9 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.

2.10 ISOLATION VALVES

- .1 Up To and including 2" (50mm) - Ball type
 - .1 Manufacturer: Kitz #859, Toyo Red & White 5049A-LF
 - .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
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.
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
 - .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
 - .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

2.11 THROTTLING VALVES

- .1 Up To and including 2" (50 mm) - Globe type:
 - .1 Manufacturer: Kitz 812, Toyo Red & White 212-LF
 - .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
 - .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)
 - .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
 - .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.

2.12 CHECK VALVES

- .1 Up To and Including 2" (50 mm):

- .1 Swing "Y" Pattern:
Screwed Ends - Kitz 822, Toyo Red & White 236A-LF
Solder Ends - Kitz 823, Toyo Red & White 237A-LF
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
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
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
Construction: Stainless Steel A351 CF8M Body, ANSI Class 150, 316 SS Trim
 - .3 Double Door – Mueller Steam Specialty Model 72H-HHH-H-H
Construction: Stainless Steel A351 CF8M Body, ANSI Class 150, 316 SS Trim
 - .4 Silent Check – Spring Loaded – Mueller Steam 101MHT / Mueller Steam 105MHT (Globe Style)
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.

2.13 DRAIN VALVES

- .1 ½" and ¾" – Ball Cap & Chain type:
 - .1 Manufacturers:
Threaded Ends: Kitz 868C, Toyo Red & White 5046-LF
Solder Ends: Kitz 869C
 - .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.

2.14 WATER PRESSURE REDUCING VALVES

- .1 Up to 2" (50 mm):
 - .1 Manufacturers:
 - .1 Armstrong Model GD 24.
 - .2 Watts Model Series 223.
 - .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.
 - .2 MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.15 RELIEF VALVES

- .1 Pressure Relief:
 - .1 Manufacturers:
 - .1 Watts Model Series 40.
 - .2 AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

2.16 STRAINERS

- .1 Up to 200 psig:
 - .1 Size 2" (50 mm) and Under:
 - .1 Manufacturers: Mueller Steam LF351
 - .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
 - .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
 - .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
 - .2 Construction: ANSI Class 150 A351 CF8M (Cast 316SS) Body, Bolted Cover, Y Pattern, 304 stainless steel screen with 1/32 perforation, Flanged Ends.

2.17 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 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

- .9 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with general trades.
- .10 Establish elevations of buried piping outside the building to ensure not less than 5'6" (1.6 m) of cover.
- .11 Install vent piping penetrating roofed areas to maintain integrity of roof assembly; coordinate with Division 07.
- .12 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.
- .13 Provide support for utility meters to requirements of utility companies.
- .14 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting where required. Coordinate with general trades.
- .15 Excavate and backfill as required for work of this Section.
- .16 Install bell and spigot pipe with bell end upstream.
- .17 Install valves with stems upright or horizontal, not inverted.
- .18 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- .19 Sleeve pipes passing through partitions, walls and floors.
- .20 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 Water main will be brought into building to a point 12" (310 mm) above floor, capped with a blank flange by trades doing outside services.

3.5 APPLICATION

- .1 Use grooved mechanical couplings and fasteners in accessible locations, risers, and pipe chases.
- .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.

3.6 ERECTION TOLERANCES

- .1 Establish invert elevations, slopes for drainage to 1 percent minimum. Maintain gradients.
- .2 Slope water piping minimum 0.25 percent and arrange to drain at low points.

3.7 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, existing 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.

3.8 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.

3.9 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).

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 SECTION INCLUDES

- .1 Domestic Water Heaters
 - .1 fuel-fired 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 Indicate pump type, capacity, power requirements.
 - .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 heat exchanger dimensions, size of tapings, 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 minimum three 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 American Gas Association (AGA).
 - .2 National Sanitation Foundation (NSF).
 - .3 American Society of Mechanical Engineers (ASME).
 - .4 National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 - .5 National Electrical Manufacturers' Association (NEMA).
 - .6 Underwriters Laboratories (UL).
- .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 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.

1.9 WARRANTY

- .1 Section 01 78 10.
- .2 Provide five year manufacturer warranty for domestic water heaters packaged water heating systems in-line circulator.

1.10 EXTRA MATERIALS

- .1 Provide two of pump seals.

2 PRODUCTS

2.1 GAD-FIRED WATER HEATERS

- .1 Manufacturer: AO Smith
- .2 Other acceptable manufacturers offering equivalent products.
 - .1 Lochinvar
 - .2 S. A. Armstrong

2.1 WATER HEATER (WH-1)

- .1 General: Commercial 96% thermal efficiency, power direct vent, maximum working pressure of 160 PSI, 1 seamless glass lined steel tank construction, automatic blower motor induced draft for direct venting, electronic ignition, protective magnesium anode rods, hand hole cleanout, Touch Screen control system & manufacturers concentric vent kit & neutralizing kit.
- .2 Supply voltage shall be 120 volt / 60 hertz / single phase/ 5 amps
- .3 Capacities and Model:
 - .1 Input (BTUH): 199,000
 - .2 Recovery @ 100F TR (USGPM): 256
 - .3 Storage (US Gallons): 100
 - .4 Model: BTH-199
 - .5 No. Required: 1
 - .6 Manufacturer: AO Smith indicated.

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 Heat Exchangers:
 - .1 Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
 - .2 Support unit on pipe stand.
 - .3 Pipe relief valves and drains to nearest floor drain.
 - .4 Connect steam branch line from top of main. Pipe in flexible manner, pitched with steam flow, with pipe union connections. Provide steam pressure gauge at exchanger inlet.
 - .5 Provide steam traps and valves as indicated.
 - .6 Pitch shell for condensate drain to traps.
- .4 Domestic Hot Water Storage Tanks:
 - .1 Provide steel pipe support, independent of building structural framing members.
 - .2 Clean and flush prior to delivery to site. Seal until pipe connections are made.
- .5 Pumps:
 - .1 Ensure shaft length allows sump pumps to be located minimum 600 mm below lowest invert into sump pit and minimum > clearance from bottom of sump pit.

- .2 Provide air cock and drain connection on horizontal pump casings.
- .3 Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
- .4 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. Provide supports under elbows on pump suction and discharge line sizes 100 mm and over.
- .5 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.
- .6 Align and verify alignment of base mounted pumps prior to 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 Water closets, seats, tanks, flush valves, supplies, carriers
- .2 Urinals, tanks, flush valves
- .3 Lavatories, faucets, spouts, waste, carriers
- .4 Stainless steel sinks, faucets, spouts,
- .5 Service sinks, traps, faucets, spouts, accessories
- .6 Mop sinks, faucets, spouts, accessories
- .7 Showers, head-arm-flange, valves, accessories
- .8 Eye and face wash, valves, fittings, accessories, signs
- .9 Drinking fountains

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 licence 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 the table as follows:

Fittings Pressure	Maximum Flow			Test	
	L/min	USgpm	IMPgpm	Psi	kPa
Lavatory Faucet (Other)	1.9	0.5	0.4	60	413
Kitchen Faucet	8.35	2.2	1.84	60	413
Shower Head (Other)	9.5	2.5	2.09	80	550

- .2 The flush cycle for each fixture that is a water closet or urinal, shall not exceed the maximum flush cycle listed in the table as follows:

Fixtures	Maximum Flush		
	L	US Gal.	Imp Gal.
Water Closet (Tank/Flush Valve) - Other	6.0	1.58	1.32
Urinal (Tank/Flush Valve)	1.9	0.5	0.42

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 Substitutions: Refer to Section 20 01 01.
 - .2 Flush Valves
 - .1 Manufacturer: Sloan
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Kohler
 - .2 Delta Commercial
 - .3 Moen
 - .4 Substitutions: Refer to Section 20 01 01
 - .3 Carrier
 - .1 Manufacturer: Watts
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Waltec
 - .2 Emco
 - .3 Zurn
 - .4 Substitutions: Refer to Section 20 01 01
 - .4 Seats
 - .1 Manufacturer: Centoco
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Benecke
 - .2 Olsonite
 - .3 Bemis
 - .4 Substitutions: Refer to Section 20 01 01.
- .3 Urinal:
 - .1 Vitreous China fixtures: American Standard
 - .1 Manufacturer:
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Kohler
 - .2 Toto
 - .3 Eljer
 - .4 Mansfield
 - .5 Substitutions: Refer to Section 20 01 01.
 - .2 Flush Valves
 - .1 Manufacturer: Sloan
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Kohler
 - .2 Delta Commercial
 - .3 Moen
 - .4 Substitutions: Refer to Section 20 01 01
 - .3 Carrier
 - .1 Manufacturer: Watts
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Waltec
 - .2 Emco

- .3 Zurn
- .4 Substitutions: Refer to Section 20 01 01
- .4 Lavatory:
 - .1 Lavatory (L1)
 - .1 Manufacturer: Franke
 - .2 Other acceptable manufactures offering equivalent products:
 - .1 Elkay
 - .2 AMI
 - .3 Substitutions: Refer to Section 20 01 01.
 - .2 Lavatory (L2H)
 - .1 Manufacturer: American Standard
 - .2 Other acceptable manufactures offering equivalent products:
 - .1 Kohler
 - .2 Mansfield
 - .3 Eljer
 - .4 Acorn
 - .5 Substitutions: Refer to Section 20 01 01.
 - .3 Lavatory Faucets
 - .1 Manufacturer: Sloan
 - .2 Other acceptable manufacturers offering equivalent products:
 - .1 Moen
 - .2 Chicago Faucet
 - .3 Kohler
 - .4 Delta Commercial
 - .5 Substitutions: Refer to Section 20 01 01.
 - .4 Waste
 - .1 Manufacturer: McGuire
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Waltec
 - .2 Emco
 - .3 Kohler
 - .4 Delta Commercial
 - .5 Zurn
 - .6 Powers
 - .7 Substitutions: Refer to Section 20 01 01.
 - .5 Supplies
 - .1 Manufacturer: McGuire
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Waltec
 - .2 Emco
 - .3 Kohler
 - .4 Delta Commercial
 - .5 Zurn
 - .6 Powers
 - .7 Substitutions: Refer to Section 20 01 01.
 - .6 Carriers
 - .1 Manufacturer: Watts
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Zurn
 - .2 J.R. Smith
 - .3 MIFAB
 - .4 Substitutions: Refer to Section 20 01 01.
- .5 Stainless Steel Sinks:
 - .1 Sink
 - .1 Manufacturer: Franke Commercial, Kindred
 - .2 Other acceptable manufacturers offering equipment products
 - .1 AMI

- .2 Elkay
 - .3 Substitutions: Refer to Section 20 01 01.
 - .2 Sink Faucet
 - .1 Manufacturer: American Standard
 - .2 Other acceptable manufacturers offering equipment products
 - .1 Delta Commercial
 - .2 Moen
 - .3 Chicago Faucet
 - .4 Kohler
 - .5 Zurn
 - .6 Substitutions: Refer to Section 20 01 01.
 - .3 Waste
 - .1 Manufacturer: McGuire
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Waltec
 - .2 Emco
 - .3 Kohler
 - .4 Delta Commercial
 - .5 Zurn
 - .6 Powers
 - .7 Substitutions: Refer to Section 20 01 01.
 - .4 Supplies
 - .1 Manufacturer: McGuire
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Waltec
 - .2 Emco
 - .3 Kohler
 - .4 Delta Commercial
 - .5 Zurn
 - .6 Powers
 - .7 Substitutions: Refer to Section 20 01 01.
- .6 Mop Sink:
 - .1 Mop Sink
 - .1 Manufacturer: Stern Williams
 - .2 Other acceptable manufacturers offering equivalent products:
 - .1 Fiat
 - .2 Zurn
 - .3 Acorn
 - .4 Substitutions: Refer to Section 20 01 01.
 - .2 Mop Sink Faucet
 - .1 Manufacturer: American Standard
 - .2 Other acceptable manufacturers offering equivalent products:
 - .1 Delta Commercial
 - .2 Chicago Faucet
 - .3 Powers
 - .4 Moen
 - .5 Substitutions: Refer to Section 20 01 01.
- .7 Showers
 - .1 Shower Trim
 - .1 Manufacturer: Moen
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Kohler
 - .2 Symmons
 - .3 Delta Commercial
 - .4 American Standard
 - .5 Powers
 - .6 Substitutions: Refer to Section 20 01 01

- .8 Bottle Filler:
 - .1 Bottle Filler
 - .1 Manufacturer: Murdock
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Elkay
 - .2 Acorn
 - .3 Bradley
 - .4 Oasis
 - .5 Substitutions: Refer to Section 20 01 01.
 - .2 Waste
 - .1 Manufacturer: McGuire
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Waltec
 - .2 Emco
 - .3 Kohler
 - .4 Delta Commercial
 - .5 Zurn
 - .6 Powers
 - .7 Substitutions: Refer to Section 20 01 01.
 - .3 Supplies
 - .1 Manufacturer: McGuire
 - .2 Other acceptable manufacturer offering equivalent products:
 - .1 Waltec
 - .2 Emco
 - .3 Kohler
 - .4 Delta Commercial
 - .5 Zurn
 - .6 Powers
 - .7 Substitutions: Refer to Section 20 01 01.
- .9 Eye/Facewash:
 - .1 Eye/facewash:
 - .1 Manufacturer: Guardian
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Bradley
 - .2 Western
 - .3 Speakman,
 - .4 Haws
 - .5 Encon.
 - .6 Substitutions: Refer to Section 20 01 01.
 - .2 Eye/facewash Thermostatic Mixing valve:
 - .1 Manufacturer: Lawler
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Haws
 - .2 Bradley
 - .3 Leonard
 - .4 Danfoss
 - .5 Substitutions: Refer to Section 20 01 01.
- .10 Washing Machine Valve Box
 - .1 Manufacturer: PPP Inc.
 - .2 Other acceptable manufacturers offering equivalent products.
 - .1 Watts
 - .2 Symmons
 - .3 Substitutions: Refer to Section 20 01 01
- .1 Institutional Combination Toilet/Basin
 - .1 Manufacturer: Acorn
 - .2 Other acceptable manufacturers offering equivalent products
 - .1 Willoughby

- .2 Bradley
- .3 Substitutions: Refer to Section 20 01 01

2.2 WATER CLOSETS, WALL HUNG, FLUSH VALVE (W1)

- .1 Bowl: ASME A112.19.2; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2" (38 mm) top spud, white.
- .2 Seat: Solid white plastic, open front, extended back, brass bolts, without cover.
- .3 Flush Valve: Chrome plated brass construction, 1-1/2" top spud, adjustable manual operated, low consumption 1.3 gpf/4.8lpf, complete with seat bumper and stop
- .4 Carrier: Heavy duty thin wall 500-Lb (227-kg) adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers, to suit application.
- .5 Manufacturers
 - .1 Bowl: American Standard 'Afwall' 3351.101
 - .2 Supplies: Delta Commercial 81T201-5
 - .3 Seat: Centoco AM500 STSCC
 - .4 Carrier: Single: ISCA-141

2.3 WATER CLOSETS, WALL HUNG, FLUSH VALVE, BARRIER FREE (W2H)

- .1 Bowl: ASME A112.19.2; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2" (38 mm) top spud, white. Installed to Barrier Free height
- .2 Seat: Solid white plastic, open front, extended back, brass bolts, with cover for barrier free fixtures.
- .3 Flush Valve: Chrome plated brass construction, 1-1/2" top spud, adjustable manual operated, low consumption 1.3 gpf/4.8lpf, complete with seat bumper and stop
- .4 Carrier: Heavy duty thin wall 500-Lb (227-kg) adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers, to suit application.
- .5 Manufacturers
 - .1 Bowl: American Standard 'Afwall' 3351.101
 - .2 Supplies: Delta Commercial 81T201-5
 - .3 Seat: Centoco 820 STS.
 - .4 Carrier: Single: ISCA-141

2.4 WATER CLOSETS, WALL HUNG, ELECTRONIC FLUSH VALVE, BARRIER FREE (W3H)

- .1 Bowl: ASME A112.19.2; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2" (38 mm) top spud, white. Installed to Barrier Free height
- .2 Seat: Solid white plastic, open front, extended back, brass bolts, with cover for barrier free fixtures.
- .3 Flush Valve: Electronic flush valve, chrome plated brass construction, 1-1/2" top spud, Sensor operated with manual override, low consumption 1.28 gpf/4.8lpf. Flush valve to be hardwired and complete with hard wire kit.
- .4 Carrier: Heavy duty thin wall 500-Lb (227-kg) adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers, to suit application.
- .5 Manufacturers
 - .1 Bowl: American Standard 'Afwall' 3351.101
 - .2 Supplies: Delta Commercial 81T201HWA - MMO
 - .3 Seat: Centoco 820 STS.
 - .4 Carrier: Single: ISCA-141

2.5 URINAL, WALL HUNG, MANUAL, FLUSH VALVE (U1)

- .1 Bowl: White vitreous china, extended shields, washout action, flushing rim, integral trap and removable strainer, outlet connection, 3/4" (20 mm) top spud connection, wall hung urinal with concealed arm carrier.
- .2 Flush Valve: Exposed flush valve , 3/4" top spud, chrome plated, low consumption - 1.9 LPF/0.5GPF,

- vacuum breaker, diaphragm type, self cleaning. Minimum flowing pressure 25 psi.
- .3 Carrier: Floor mounted urinal carrier with heavy gauge steel uprights with integral welded feet, universal steel hanger support plate and bottom bearing plate hardware.
- .4 Manufacturers
 - .1 Urinal: American Standard Washbrook 6590.001
 - .2 Flush Valve: Delta Commercial 81T201
 - .3 Carrier: Watts CA-321

2.6 LAVATORY, UNDER COUNTER MTD (L1)

- .1 Lav: Under mount, white vitreous china, overflow, self rimming, bowl size 18"x12"x6-7/8", nominal size: 19-3/4" x 13-3/4".
- .2 Faucet: Faucet: Deck mounted, chrome plated cast brass, blade hands, 8" 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, locksheild screwdriver slot, stuffing box cartridge, brass supply nipple, 12.7mm (1/2") OD x 305mm (12") long flexible riser, stainless steel wall flange
- .5 Manual Mixing Valve: 1/2" lead free hot water temperature control valve, 60-120F control, integral check valves, double throttling design.
- .6 Manufacturers
 - .1 Lav: American Standard Studio 0614.300
 - .2 Faucet: Moen 9220F05
 - .3 Waste: Delta Commercial 33T260
 - .4 Supplies: Delta Commercial 47T2622SD

2.7 LAVATORY, WALL HUNG (L2H)

- .1 Lav: wall hung, white vitreous china, drilled for faucet, overflow, self rimming complete with shroud for piping. Must be Barrier Free OBC compliant.
- .2 Faucet: Deck mounted, chrome plated cast brass, blade hands, 8" 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 ie 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, locksheild 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 Murro Universal 0954.908EC & 0059.020EC
 - .2 Faucet: Moen 9220F05
 - .3 Waste: Delta Commercial 33T290
 - .4 Supplies: Delta Commercial 47T2622SD
 - .5 Carrier: Watts WCA-411-CA-481

2.8 SINK, 1 COMP, GOOSENECK SPOUT (S1)

- .1 Bowl: Single compartment, counter mount, 18 gauge, 304 stainless steel, drilled for faucet specified, undercoated, 3-1/2" waste strainers. Overall: 20-1/2 x 20" O.D. Bowls: 16" x 18" x 8" deep.
- .2 Faucet: deck mounted ,8" centres, blade handles, vandal resistant flow control aerator, 1.2 gpm, Wallform 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 LBS6810P
 - .2 Faucet: Moen Series 8248SMF12
 - .3 Supplies: Delta Commercial 47T2622SD
 - .4 Waste: Delta Commercial 33T360

2.9 SINK, 2 COMP, GOOSENECK SPOUT (S2)

- .1 Bowl: Double compartment, counter mount, 18 gauge, 304 stainless steel, drilled for faucet specified, undercoated, barrier free installation, 3-1/2" waste strainers. Overall: 31.26" x 18.82" O.D. Bowls: 14" x 14" x 8" deep.
- .2 Faucet: deck mounted, blade handle, 8" centre, 1.5 gpm, 8" spout reach, vandal resistant.
- .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: LBD4408P-1
 - .2 Faucet: Moen 8225
 - .3 Supplies: Delta Commercial 47P2512SD

2.10 JANITOR SINK, MOLDED STONE (JS)

- .1 Sink: 24"x24"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 wallmount 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-900
 - .2 Faucet : Stern Williams Model T-10-VB
 - .3 Accessories: Stern Williams Model T-35, T-40
 - .4 Fitting: Moen 8124

2.11 SHOWER (SH1)

- .1 Enclosure: By others
- .2 Fitting: Polished chrome plated finish, pressure balance, limit stop for pre-setting maximum temperature, integral volume control, single lever, heavy duty forged brass body.
- .3 Shower Head: 1.5 GPM, vacuum breaker
- .4 Waste: Provide 'P' trap
- .5 Manufacturer:
 - .1 Fitting & Head: Moen 'M-Dura' T9375EP15

2.12 SHOWER, BARRIER FREE (SH2H)

- .1 Enclosure: By others
- .2 Fitting: Polished chrome plated finish, pressure balance, limit stop for pre-setting maximum temperature, integral volume control, single lever, heavy duty forged brass body.
- .3 Handheld Shower: 1.5 GPM, vacuum breaker 72" chrome plated flexible hose. 24" combination stainless steel slide grab bar.
- .4 Waste: Provide 'P' trap
- .5 Manufacturer:
 - .1 Fitting & Head: Moen 'M-Dura' T9346GBM15

2.13 BOTTLE FILL STATION (BF)

- .1 Bottle filling station, filtered, refrigerated stainless. Antimicrobial, hands free, laminar flow, drain. Electronic bottle filler sensor, in-wall mounted. Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120. Unit complete with chiller.
- .2 Electrical: 115V/60Hz.

- .3 Manufacturer:
 - .1 Bottle Fill: Elkay LZWSM8C

2.14 WALL HUNG EYEWASH (EW)

- .1 Eye/face wash: Eye and face wash chrome plated brass sprayhead assembly complete with pop-off eyewash head covers and stainless steel bowl.
- .2 Valves: Stay-open eyewash valve activated by stainless steel push flag handle
- .3 Pipe and Fittings: Galvanized steel complete with trap. Pipe to sanitary system.
- .4 Wall Bracket: Pre-assembled cast-aluminum
- .5 Emergency mixing valve system with integral cold water by-pass. Solid bi-metal thermostat, hot water shut down on failure of cold water supply, high temperature limit stop set to 90°F (32°C), combination checkstops, strainers on inlets, outlet dial thermometer rough bronze finish, factory assembled and tested. Capacity: 4.5gpm @ 10PSI Pressure drop.
- .6 Manufacturer:
 - .1 Eye/Facewash: Haws 7360BT-7460BT
 - .2 Mixing Valve: Haws Model TWBS.EWE

2.15 WASHING MACHINE VALVE BOX (WMV)

- .1 General: Control valve with triple-seal packing, self-adjusting, spring-loaded, non-wearing action, Flush to wall cover, paintable surface, 2" (50mm) drain outlet, metal mounting flanges, Serviceable/replaceable valve, Service stops, Dimensions: Box: 210 x 140 x 96 mm (8 1/4" 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 LM600

2.16 INSTITUTIONAL COMBINATION TOILET/BASIN (PW1)

- .1 Fixture: Designed to be installed on floor and serviced from accessible service chase behind. 14 gage (1.9 mm) type 304 S.S. cabinet with bowl and lavatory, all seamless welded construction with a satin finish, mounting hardware, wall plate or sleeve for mounting. For bowl orientation refer to drawings.
- .2 Lavatory: standard oval bowl 14-3/4" x 9-1/2" x 5" (375 x 241 x 127mm) deep, self draining soap dish.
- .3 Faucet Valve: Air-control, pneumatically operated, push button valve, flow control, remote mounting.
- .4 Flush Valve: 1.28 GPF, manual flush.
- .5 Toilet: Blowout, elongated, 18" (457 mm) high integral seat.
- .6 Manufacturer:
 - .1 Acorn 1418-CT-2-04-HET-1.28 GPF-FV, Refer to drawing for bowl orientation.

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 20 05 00 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

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

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 will 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
- .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

- .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
- .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 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*
- .2 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 ACOUSTIC INSULATION

- .1 Refer to Section 23 32 48.

2.6 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 or altered 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"
Air supply runouts to terminal units < 10' in length - Rectangular	rigid	1"
Air supply runouts to terminal units < 10' in length - Round	flexible	1"
Fresh air from DOAS/ERV to Fan Coil Unit	flexible	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

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
Fresh air from DOAS/ERV to Fan Coil Unit	flexible	40mm

- .2 Inline duct silencers shall be insulated in the same manner as ductwork.

3.3 INSTALLATION

- .1 Install duct insulations 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 canvas jacket sized for finish painting or finish with PVC Jacket.

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 Glycol/water piping system.
 - .3 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 manufacturers 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 (3) years documented experience.
- .2 Installer: Company specializing in performing the work of this section with minimum three (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 (2) repacking kits for each size and valve type.

2 PRODUCTS

2.1 VALVES - GENERAL

- .1 Manufacturers:
 - .1 Kitz.
 - .2 Crane
 - .3 Conbraco.
 - .4 Nibco
 - .5 Jenkins
 - .6 Bray
- .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	Normal 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, schedule 40, black
.7	Joints 2" (50mm) and smaller	Screwed
.8	Screwed Fittings	150 Lb. malleable iron
.9	Unions	Class150, ASTM A-47 malleable iron, ASTM A-153 galvanized, ANSI B2.1 threads.
.10	Joints 2-1/2" (65mm) and larger	Welded with flanges at connections to equipment
.11	Butt weld fittings	ASTM A234 Gr. WFB
.12	Flanges	ASTM A105, Class 150, raised face, weld neck or slip on
.13	Bolts	ASTM A307 C.S. bolts, square head; ASTM A563 nuts, hex head
.14	Gaskets	1/16" (1.6mm) thick, preformed non-asbestos graphite fibre.
.15	Copper Tubing 2" (50mm) and smaller	ASTM B88, Type L, hard drawn
.16	Joints	Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range of 220°C to 280°C.
.17	Fittings	ASME B16.18, cast brass, or ASME B16.22, solder wrought copper
.18	Valves 2" (50mm) and smaller	ASTM A105
.19	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 Valve (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 and stem, lever handle, threaded ends KITZ #68AC.
.20	Valves 2-1/2" (65mm) and larger	ASTM A216 WCB
	Gate Valves (Isolating)	200 psig non-shock WOG, ASTM A216 Class B cast iron body, bolted bonnet, bronze mounted, solid wedge disc, OS&Y, non-asbestos packing, flanged ends KITZ #72
	Globe Valves (Throttling)	200 psig non-shock WOG, ASTM A126 Class B cast iron body, bolted bonnet, bronze mounted, beveled wedge disc, OS&Y, non-asbestos packing, flanged ends KITZ #76
	Butterfly Valves (Isolating)	300 psig CWP, ASTM A536 ductile iron body, elastomer seat (pressure responsive in sizes through 12" (600mm)) and stainless-steel stem. (Stem shall be offset from the disc centreline to provide complete 360-degree circumferential seating) Lever handle or gear operator as required.
	Check (Backflow)	1. 200 psig non-shock WOG, ASTM 126 Class B cast iron body, bolted cover, bronze mounted, swing type disc, flanged ends KITZ #78
.21	High Performance Butterfly Valves (Isolating) 2" (50mm) and smaller	Class 150, Carbon Steel Body, stainless-steel shaft, stainless-steel disc, RPTFE seat and packing.
.22	High Performance Butterfly Valves (Isolating) 2-1/2" (65mm) and larger	Class 150, Carbon Steel A216WCB Body, 17-4 stainless-steel shaft, stainless-steel disc, RPTFE seats and packing. Valve shall have bubble tight shut-off to 200 psig when downstream flange is removed (Full dead-end service. Valves 6" (150mm) and smaller shall have locking lever operator, WKM Class 150 B5113-02-S02011HL (lever)
.23	Strainers 2" (50mm) 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
	Strainers 2-1/2" (65mm) and larger	Class 250 psig non-shock WOG, cast iron, Y-pattern, flange cover, blow-out plug, A167 304 stainless-steel screen with 1/32" perforation, flanged ends Mueller Steam 752
.24	Provide stem extensions for insulated piping	
.25	Provide gear operator and chain on valves installed above 10'-0" (3.0 metre) above finished floor	

2.3 EQUIPMENT DRAINS AND OVERFLOWS

- .1 Copper Tubing: ASTM B88, Type M and DWV, hard drawn.
- .2 Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
- .3 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 428°F to

536°F (220°C to 280°C).

2.4 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

.2 Circuit Balancing Valves 2 1/2" (65 mm) and larger

- .1 [Flanged] or [grooved] ends, line size connection, globe style design, nonferrous, pressure die-cast, nonporous A metal Copper Alloy or ductile iron. 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 recommendation.
 - .1 Valves, shall provide the following functions:
 - .2 Precise flow measurement.
 - .3 Precision flow balancing.
 - .4 Positive shut off with no drip seat and teflon disc.
- .2 Valves shall have twelve 360° adjustment turns of handwheel for maximum vernier-type setting with "Hidden Memory" feature to program the valve with precision tamper-proof balancing setting.
- .3 Valves shall be suitable for maximum working pressure of 250 psi (1720 kPa) and maximum operating temperature of 250°F (120°C).
- .4 Acceptable Products:
 - .1 S.A. Armstrong CBV-SF (CBV-SF replacing the previous S.A. Armstrong CBV II model)
 - .2 IMI Engineering STAF (Tour & Anderson STA-F/STA-G was bought-out by IMI)
 - .3 VICTAULIC TA 788 (Newman Hattersley don't appear to make large valves anymore)

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 and 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 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 -34°C to 110°C.
- .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 and glycol 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) and 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 and 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 recirculating 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.
 - .1 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 convactor 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.
 - .2 Automatic Feed Valves: provide automatic feed valve on the cold-water make-up line to each new hot water heating system.
 - .3 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).

- .4 Air Eliminators
 - .1 Air Eliminators: provide an air eliminator at each new air cushion (expansion) tank.
- .5 Circuit Balancing Valve (CBV):
 - .1 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.
- .6 Supply and install threaded couplings or half coupling for flow switches that are supplied under Section 25
- .7 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 heating coils. Note rise or drop of temperatures from source.
 - .6 Balance each 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 20 05 00 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Expansion tanks.
- .2 Air vents.
- .3 Air and Dirt 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.

1.8 MAINTENANCE SERVICE

- .1 Provide service and maintenance of glycol system for one (1) year from date of substantial completion.
- .2 Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

1.9 EXTRA MATERIALS

1. Provide one extra 1 gal. (4 L) drum of propylene glycol.

2 PRODUCTS

2.1 DIAPHRAGM TYPE EXPANSION TANKS

- .1 Manufacturers:
 - .1 Amtrol
 - .2 Expan-flex
 - .3 Bell & Gossett-Xylem
 - .4 Armstrong
 - .5 Taco
 - .6 Calefactio
- .2 Construction: Welded steel, tested and stamped to ASME Section VIII, Division 1; 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 or steel saddles for horizontal installation.
- .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 BLADDER TYPE EXPANSION TANKS

- .1 Manufacturers:
 - .1 Amtrol
 - .2 Expan-flex
 - .3 Bell & Gossett-Xylem
 - .4 Armstrong
 - .5 Taco
 - .6 Calefactio
- .2 Construction: Welded steel, tested and stamped to ASME Section VIII, Division 1; supplied with National Board Form U-1, rated for working pressure of 125 psi (860 kPa), with full or partial acceptance replaceable butyl bladder 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.

2.3 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
 - .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.

2.4 AIR AND DIRT SEPARATORS

- .1 Air Separators:
 - .1 Manufacturers:

- .1 Amtrol ADS Series
- .2 Caleffi
- .3 Armstrong.
- .4 Bell & Gossett-Xylem
- .5 Taco
- .6 Expanflex
- .2 Description:
 - .1 Steel, tested and stamped to ASME SEC 8-D; for 125 psi (860 kPa) operating pressure.
 - .2 Tangential inlet and outlet connections, and internal stainless steel air collector tube.
 - .3 2" (50mm) top and bottom connections for installation of air vent and blow down valve.
 - .4 Stainless steel mesh screen to remove dirt up to 5 microns.
 - .5 Include magnetic separator with dry-well for service.
 - .6 Provide model to match line size of piping.

2.5 STRAINERS

- .1 Refer to 20 05 00.

2.6 RELIEF VALVES

- .1 Manufacturers:
 - .1 Sarco.
 - .2 Watts
 - .3 Bell & Gossett-Xylem
 - .4 Conbraco
- .2 Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled

2.7 BUFFER TANK

- .1 Manufacturers:
 - Amtrol
 - Taco
- .2 Furnish and install, as shown on plans, an AMTROL Inc. Buffer Tank of 120 gallons. The unit shall have (NFT/flanged/grooved) inlet and outlet connections with sizes as identified on drawings/schedules. An NPT vent connection shall be fitted to the top and a NPT drain connection shall be fitted to the bottom of the vessel. Tanks shall be fitted with an internal baffle to circulate the water and take full advantage of the tank volume and promote temperature stratification.
- .3 The Buffer Tank must be designed, constructed, and stamped for 125 psig @ 450°F (232°C) in accordance with most recent addendum of ASME section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. The Buffer Tank shall be painted with one shop coat of red oxide primer.
- .4 Buffer tank shall be lined with epoxy baked lining.
- .5 Buffer tank shall be installed with insulation and jacket to meet the requirements of ASHRAE 90.1.
- .6 Buffer tank shall include welded angle iron legs or base ring for tank supports.
- .7 Size: As scheduled.

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 20 05 00 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

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 (2) refrigeration oil test kits each containing everything required to conduct one test.
- .2 Provide two (2) 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

- 1480°F (640 to 805° 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 200°F (93°C).

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 300°F (149°C).
- .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 300°F (149°C).
- .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 200°F (93°C).

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 sterilant
 - .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 20 05 00 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Cleaning of pipe and fittings
- .2 Cleaning of equipment
- .3 Supply, installation testing and adjusting of chemical feed equipment.
- .4 Chemical treatments of piping systems and boilers
- .5 Supply of chemicals

1.4 SUBMITTALS

- .1 Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics, and connection requirements.
- .2 Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- .3 Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
- .4 Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- .5 Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.5 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. Company to have local representatives with water analysis laboratories and full-time service personnel.
- .2 Installer: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.
- .2 Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

1.7 MAINTENANCE MATERIALS

- .1 Provide sufficient chemicals for treatment and testing during warranty period.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Suez Water Technologies and Solutions
- .2 Rochester Midland
- .3 DuBois (Klenzoid)

- .4 Chem-Aqua
- .5 Nalco Ecolab
- .6 Chemical Supply Company
- .7 Keytech

2.2 MATERIALS

- .1 System Cleaner:
 - .1 Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tripoly phosphate and sodium molybdate.
 - .2 Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.
- .2 Closed System Treatment (Water):
 - .1 Sequestering agent to reduce deposits and adjust pH; polyphosphate.
 - .2 Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
 - .3 Conductivity enhancers; phosphates or phosphonates.
- .3 Chemicals:
 - .1 Provide all chemicals required for cleaning and start-up of systems.
 - .2 In addition, provide 3 months supply of chemicals for each system in full operation.

2.3 BY-PASS (POT) FEEDER

- .1 2 gal (7.6 litre) up to 10,000-gallon closed loop volume or 5 gal. (18.9 litre) up to 30,000 gallon closed loop volume, welded steel, quick opening cap, pressure rating of 165 psi (1.14 MPa) or 300 psi (2.07 MPa), temperature rating: 200°F (93° C).
- .2 Micron filter for each pot feeder:
 - .1 Capacity 2% of pump recirculating rate at operating pressure.
 - .2 Six (6) sets of filter cartridges for each type, size of micron filter.

2.4 SOLUTION TANKS

- .1 30 Gal. (114 L) capacity, High density molded polyethylene, self-supporting, 1 Gal. (3.8 L) level graduation markings; molded fibreglass cover with recess for mounting pump, agitator, and liquid level switch.
- .2 Provide stand only when direct feed system from shipping containers cannot be provided.

2.5 MAKE-UP WATER METER

- .1 Bronze, capacity to meet requirements, non-reset electric cumulative totalizer, electric contacting register.

2.6 CONDUCTIVITY PROBES

- .1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.
- .2 ORP-Oxidation Reduction Potential Control Circuit shall be capable of measuring 0-1000 Mv in 1 Mv increments. Controller shall feature an adjustable set point, differential, high alarm, low alarm and feed limit timer.

2.7 WATER SOFTENER

- .1 General: 2 sodium zeolite exchanger[s] with common brine tank with Eductor and Manifold.
- .2 Performance: to reduce effluent hardness to less than [1] ppm.
- .3 Control:
 - .1 Automatic feature to prevent regeneration of both exchangers at same time.
 - .2 Individual metres with solenoid operated diaphragm valves to regenerate unit whenever set quality L have passed through softener.

- .3 Water meter:
 - .1 Provide totalizing water metre.
 - .2 Refer to Section 22 11 19 - Plumbing Specialties.

2.8 TEST EQUIPMENT

- .1 Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4 - 10 ml zeroing titrating burettes and associated reagents.
- .2 Provide one set of test equipment for each system to verify performance including;
 - .1 Alkalinity titration test kit.
 - .2 Chloride titration test kit.
 - .3 Sulphite titration test kit.
 - .4 Total hardness titration test kit.
 - .5 Low phosphate test kit.
 - .6 Conductivity bridge, range 0 - 10,000 microhms.
 - .7 Creosol red pH slide complete with reagent.
 - .8 Portable electronic conductivity meter.
 - .9 High nitrite test kit.

2.9 CLOSED SYSTEMS WATER TREATMENT INCLUDING HOT AND GLYCOL LOOPS

- .1 Provide complete water treatment equipment and chemicals for corrosion protection, and sidestream filtration, for each closed system.
- .2 Each Closed System to include the following water treatment equipment:
 - .1 One (1) Bypass Feeder, 2 gal (7.6 litre) up to 10,000-gallon closed loop volume or 5 gal. (18.9 litre) up to 30,000 gallon closed loop volume
 - .2 One (1) Bypass Filter Unit with the capacity to handle 2.5 - 5% of the recirculating pump flow rate.
 - .3 One (1) case of 30 pieces, filter cartridges, 20 micron rated.
 - .4 One (1) corrosion coupon station, 3/4" (19mm) black iron assembled, 4 coupon port connections, 8 gpm (0.5 l/s) flow regulator.
 - .5 One (1) Copper corrosion coupon, holder, and plug.
 - .6 One (1) Mild Steel corrosion coupon, holder, and plug.
- .3 Each Glycol System to include water treatment equipment as indicated above with the addition of an automatic glycol feed system.
 - .1 Glycol: inhibited propylene glycol blended with corrosion inhibitors and buffers. Drew FSI P glycol.
 - .2 Glycol system feeder System with 55 gallon (208 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, 1/2" 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 115/1/60 0.7 A. Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.
 - .3 Options: Low level Alarm Panel c/w Remote Monitoring Dry Contacts and Selectable Audible Alarm
 - .4 Manufacturer: Axiom Industries Ltd. Model SF100, ITT (Bell and Gossett), Armstrong, Klenzoid. Other acceptable manufacturers: Neptune, Bell & Gossett Xylem, Klenzoid, Armstrong, Calefactio.
- .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 PREPARATION

- .1 Systems to be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- .2 Place terminal control valves in open position during cleaning.
- .3 Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

- .1 Concentration:
 - .1 As recommended by manufacturer.
 - .2 2.2 lbs per 265 gallons (1 kg per 1000 L) of water contained in the system.
 - .3 2.2 lbs per 265 gallons (1 kg per 1000 L) of water for hot systems and 2.2 lbs per 132 gallons (1 kg per 500 L) of water for cold systems.
 - .4 Fill steam boilers only with cleaner and water.
- .2 Hot Water Heating Systems:
 - .1 Apply heat while circulating, slowly raising temperature to 160°F (71°C) and maintain for 12 hours minimum.
 - .2 Remove heat and circulate to 100°F (37.8°C) or less; drain systems as quickly as possible and refill with clean water.
 - .3 Circulate for 6 hours at design temperatures, then drain.
 - .4 Refill with clean water and repeat until system cleaner is removed.
- .3 Use neutralizer agents on recommendation of system cleaner supplier and approval of Consultant.
- .4 Flush glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.
- .5 Remove, clean, and replace strainer screens.
- .6 Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

- .1 Install to manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

- .1 Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- .2 Introduce closed system treatment through bypass feeder when required or indicated by test.
- .3 Provide 3/4" (19 mm) water coupon rack around circulating pumps with space for 4 test specimens.

3.5 CLOSED SYSTEMS

- .1 Equipment Installation
 - .1 Install the feeder and filter in a by-pass arrangement across the headers of the primary pump set. Isolation, venting and drain valves to be installed as per installation drawing and on-site instruction by water treatment representative. Installation and electrical connections as required is the responsibility of the Mechanical Trade.
- .2 System Flushing
 - .1 Thoroughly flush the closed system(s) with raw water to remove loose mill scale and debris. Remove and clean all strainers and flush low points before chemical cleaner is added to the system.
- .3 Add new system cleaner CSW 600 at 15 -20 lbs per 1004 gallons (6.8 - 9 kg per 3800 litres) system water for the removal of oil, mill scale and iron oxides. Recirculate for a minimum of 24 hours and flush. Repeat fill and flush procedure as often as required, adding inhibitor with each fill, to achieve prescribed maintenance levels.
- .4 Acceptability of water condition to be determined through testing and visual examination of representative water samples, by the water treatment supplier. Copies of test reports to be submitted by the water treatment supplier to the Mechanical Trade for verification to the Engineer.
 - .1 Add corrosion inhibitor CSW 311 at 51 lbs per 1004 gallons (23 kg per 3800 litres) to the final waster fill to achieve prescribed maintenance levels.
 - .2 Insert cartridges in filter.

3.6 MAINTENANCE

- .1 Maintain inhibitor levels and other water quality control ranges as they apply, from the time the system is brought on-line after flushing and cleaning, up to Substantial Completion of contract. The chemical supply allotment provided by the water treatment supplier is effective from the time the system is brought online.
- .2 The water treatment supplier shall provide all necessary supervision during installation and shall test the system over the course of the construction period to ensure that proper treatment is being maintained, up to Substantial Completion. Reports generated by the water treatment supplier and left on-site are to be compiled for the Engineer's review.
- .3 The water treatment supplier shall provide a chemical supply service program for a period of one year from Substantial Completion. This program shall include training of operating personnel, laboratory testing as required, technical assistance and routine water analysis and recommendations.
- .4 Frequency of service calls by the water treatment supplier to be sufficient to meet system stability requirements.

3.7 CONDENSER WATER SYSTEMS (COOLING TOWERS)

- .1 Provide automatic condenser water control systems for inhibitor feed, blowdown, and biocide feeds. Meter activate inhibitor application, conductivity activate blowdown, and meter feed biocide with blowdown locked out to ensure biocide retention time.
- .2 Incorporate solid state integrated circuits and digital LED displays in NEMA-12 steel control enclosure. Provide gasketed and lockable door.
- .3 Base dissolved solids control on conductivity and include:
 - .1 LED digital readout display (microhm/cm).
 - .2 Temperature compensated sensor probe adaptable to sample stream manifold.
 - .3 High, low, normal conductance indicator lights (LED).
 - .4 High or low conductance alarm light (flash or steady switch), trip points field adjustable. Provide flash or steady switch with silence position.
 - .5 Illuminated legend to indicate "ALARM" whenever alarm condition exists.
 - .6 Hand-off-automatic switch for solenoid bleed valve.
 - .7 Illuminated legend to indicate "BLEED" when valve is operated.
 - .8 Adjustable hysteresis or dead band (internal).
- .4 Base inhibitor feed control on make-up volume and include:
 - .1 Solid state counter (1-15 field selectable).
 - .2 Solid state timer (adjustable 1/4 to 5 minutes).
 - .3 Test switch.
 - .4 Hand-off-automatic switch for chemical pump.
 - .5 Illuminated legend to indicate "FEED" when pump is activated.
 - .6 Solid state lock-out timer (adjustable 1/4 to 3 hours) and indicator light. Provide lock-out timer to deactivate the pump and activate alarm circuits.
 - .7 Panel totalizer (amount of makeup), electro-mechanical type.
- .5 Biocide programmer to include:
 - .1 24 hour timer with 14 day skip feature to permit activation any hour of the day.
 - .2 Precision solid state bleed lock-out timer (0-9 hours) and biocide pump timer (0 - 2-1/4 hours), clock controlled.
 - .3 Solid state alternator to enable the use of two different formulations.
 - .4 Digital display of the time of day (24 hours).
 - .5 LED display of day of week (14 days).
 - .6 Fast and slow clock set controls (internal).
 - .7 Battery back-up so clock is not disturbed by power outages, quartz timekeeping accuracy.
 - .8 Hand-off-automatic switches for biocide pumps.
 - .9 Illuminated legend to indicate "BIOCIDE A" or "BIOCIDE B" when pump is activated.
- .6 Provide water meter on system make-up, wired to control system.
- .7 Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Provide agitator as required.
- .8 Provide conductivity controller to sample condenser water and operate 10" (275 mm) solenoid bleed

- valve and piping to blowdown controller sampler wired to open when condensing water pump is operating.
- .9 Introduce biocide to tower by intermittent slug feed.
 - .10 Provide liquid level switch in each solution tank to de-activate solution pump and agitator, and sound local alarm bell.
 - .11 Provide 3/4" (19 mm) water coupon rack around circulating pumps with space for 4 test specimens.

END OF SECTION

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 Firewall duct penetrations; fire and smoke dampers; louvers and access doors.
 - .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.

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/ft ²) 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.
Concealed wet exhaust from dishwashers, vents, and other utility applications.	Type 304 steel sheet per ASTM A480 and ASTM A240 with a 2B finish. Ducts shall have longitudinally welded seams and welded or flanged transverse joints and connections to equipment or accessories.
Breeching and chimneys	Black steel to ASTM A621 Specification for Steel Sheet and Strip Carbon Hot Rolled Drawing Quality. All seams and joints continuously welded.

- .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 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
Dishwasher exhaust duct	Negative	4	A	0

2.3 DUCT SEALING

.1 Duct Sealing Requirements

SEAL CLASS	SEALING REQUIREMENTS
A	All tranverse joints, longitudinal seams and duct wall penetrations
B	All tranverse joints and longitudinal seams a
C	All tranverse 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

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

- .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

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; [Except for Fire Rated Ventilation Ductwork or Fire Rated Kitchen Exhaust Grease Duct which shall comply with ULC Listing and manufacturer's instructions]

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 Arrange access door swings so that fan static pressure holds door in closed position.
- .19 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.
- .20 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.
- .21 Perform duct leakage testing for all ductwork installed under this contract.
- .22 Paint all visible internal portions of duct outlets to grilles dull black. Internal painting of ductwork behind grilles shall be by Sheet Metal Contractor.
- .23 Seams and penetrations in ductwork and plena shall be sealed in accordance with seal classifications as described in SMACNA and ASHRAE.
- .24 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.

- .25 Install rooftop ductwork such that there is a minimum of 36" (900mm) clearance between bottom of duct and top of roof for access to fuel-fired appliances, as per CSA B149.1.

3.2 CORRIDOR PENETRATION DUCTWORK

- .1 Site measurement shall be taken before fabrication in the factory shall begin.
- .2 The ductwork, joints, hangers, access doors and all other accessories shall be manufactured and installed as per manufacturer's instructions and in accordance with the ULC listing, meeting the requirements of NFPA 96.
- .3 The final installation shall be inspected and approved by the duct manufacturer. Contractor to submit letters from manufacturer to authority having jurisdiction verifying undertaking to inspect and final approval.

3.3 FLEXIBLE DUCTWORK

- .1 Flexible ductwork may be installed for final connections to air outlets provided that not more than 5 ft. (1.5 m) 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.

3.4 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 ductworks 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.

3.5 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 three (3) copies 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 Division 25.
- .2 Install remote mounted control dampers for airflow control. Supply of damper actuators and controls wiring will be under Mechanical Division 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 20 05 00 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Air Turning Devices-Turning Vanes
- .2 Backdraft Dampers
- .3 Volume Control Dampers
- .4 Fire Dampers
- .5 Combination Smoke/Fire Dampers
- .6 Duct Access Doors
- .7 Duct Test Holes
- .8 Flexible Duct Connections
- .9 Hangers and Supports
- .10 Duct Lining
- .11 Firestats
- .12 Duct Sealants
- .13 Motorized dampers
- .14 Actuators

1.4 REFERENCES

- .1 National Fire Protection Association
 - .1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
 - .3 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 (2) 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
- .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 BACKDRAFT DAMPERS

- .1 Manufacturers:
 - .1 Price
 - .2 Duro-Dyne
 - .3 Dyn-Air
 - .4 Ruskin
 - .5 Lawson & Taylor
 - .6 Ventex/Alumavent
- .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.

2.3 VOLUME CONTROL DAMPERS

- .1 Manufacturers:
 - .1 Price
 - .2 Duro-Dyne
 - .3 Dyn-Air
 - .4 Lawson & Taylor
 - .5 Ruskin
- .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.

2.4 FIRE DAMPERS

- .1 Manufacturers:
 - .1 Price
 - .2 Ruskin DIBD2/DIBD23
 - .3 Ventex
 - .4 Controlled Air
 - .5 Nailor
- .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 165°F (74°C) 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.

2.5 COMBINATION FIRE/SMOKE DAMPERS

- .1 Manufacturer:
 - .1 Ruskin Model FSD60
 - .2 NCA Mfg. Inc.
 - .3 Nailor
 - .4 Greenheck
 - .5 Price
 - .6 Controlled Air
 - .7 Ventex
 - .8 United Enertech
- .2 General:
 - .1 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.
 - .2 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.
 - .3 Links shall comply with ULC S505 "Standard for Fusible Links for Fire Protection Service".
 - .4 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.
 - .5 Provide with each damper, detailed installation instructions. Include illustrations and adequate information to attain proper and safe installation of the smoke/fire damper assembly.
- .3 Construction
 - .1 Construct frame from 1.6mm (16 gauge) galvanized steel.
 - .2 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. Sleeve and breakaway connections to suit fire rated separation construction. Provide a stainless-steel spring.
- .3 Fabricate all dampers from galvanized steel except in copper, stainless steel or aluminum duct systems. In these systems, use all stainless-steel construction.
- .4 Electric Fuse Link Heat-actuated temperature release device to close and lock damper during test, smoke detection, power failure, or fire condition through actuator closure spring. Allow damper to be automatically reset after test or power failure.
- .5 Provide factory mounted external damper actuators, mounted out of air stream, for complete cUL listed and tested damper assembly. Actuator power shall be 120V, 60 Hz, two-position, fail close.
- .4 Accessories
 - .1 Factory installed smoke detectors rated for no flow condition
 - .2 Damper test switch.
 - .3 Electric Fuse Link

2.6 DUCT ACCESS DOORS

- .1 Manufacturers:
 - .1 Acudoor
 - .2 Duro-Dyne
 - .3 Dyn-Air
 - .4 Nailor
 - .5 Kreuger
- .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.

2.7 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
- .2 Provide test ports to suit intended application, (ie. 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, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.8 FLEXIBLE DUCT CONNECTIONS

- .1 Manufacturers:
 - .1 Duro-Dyne
 - .2 Dyn-Air
 - .3 Lawson & Taylor
- .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.

2.9 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.

2.10 DUCT LINING

- .1 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.

2.11 FIRESTATS

- .1 Manual reset safety devices designed to break line or control voltage contact for fans as air temperature reaches a predetermined level.
- .2 Acceptable Products: Honeywell #L4029F, Johnson Controls, or Siemens.

2.12 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.

2.13 MOTORIZED DAMPERS-EXPOSED TO OUTDOOR AIR

- .1 Manufacturers:
 - .1 Tamco series 9000 thermally insulated damper
 - .2 Ruskin
 - .3 Nailor
 - .4 Ventex/Alumavent
- .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 available with either opposed blade action or parallel blade action
- .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".

2.19 ELECTRONIC DAMPER ACTUATORS

- .13 Manufactured, brand labeled or distributed by BELIMO or approved equivalent.
- .14 Size for torque required for damper seal at load conditions.
- .15 Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
- .16 Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
- .17 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.
- .18 Fail-Safe Operation: Mechanical, spring-return mechanism.
- .19 Power Requirements (Spring Return): 120 V ac, maximum 10 VA at 24-V ac or 8 W at 24-V dc.
- .20 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.
- .21 Temperature Rating: -22 to +122°F (-30 to +50°C)
- .22 Housing: Minimum requirement NEMA type 2 mounted in any orientation.
- .23 Agency Listing: ISO 9001, cULus, and CSA C22.2 No. 24-93.
- .24 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 Provide combination fire/smoke dampers as required closures in duct penetrations of fire separations to conform with the O.B.C., including public corridors, assembly, care, care and treatment, detention or residential occupancies.

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 turning vanes and 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.

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 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Roof Exhaust Fan
- .2 Ceiling Exhaust Fan
- .3 Lint Filters

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 ROOF EXHAUST FAN

- .1 Greenheck model GB or equivalent products by;
 - .1 PennBarry
 - .2 Twin City
 - .3 Loren Cook

- .4 Carnes
- .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: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2" (13 mm) mesh, .08" (2 mm) 16 gauge aluminum birdscreen; square base to suit roof curb with continuous curb gaskets.
- .5 Roof Curb: 24" (600mm) high self-flashing of aluminum with continuously welded seams, built in cant strips, and factory installed nailer strip. Provide burglar bars in roof curb.
- .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: Motorized Damper: Model VCD, electric actuator, aluminum multi-blade construction, TPE blade seal.
- .8 Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ceramic ball bearings and shaft grounding rings.

2.2 CEILING CABINET FAN

- .1 Greenheck Model SP-A or equivalent product by:
 - .1 Penn Barry
 - .2 Twin City
 - .3 Loren Cook
 - .4 Carnes
- .2 Direct drive, forward curved centrifugal fan, constructed of galvanized steel. The housing interior shall be acoustically lined with 1/2" (13mm) thick acoustical insulation. This discharge outlet shall be adaptable to horizontal or vertical positions. The terminal box shall be internally mounted for motor hook-up. The motor shall be mounted on resilient elastic grommets and have built in thermal overload protection and plug-in power assembly. Model SP-A shall have white baked enamel white aluminum grille. Time delay switch to be interlocked with light switch.
- .3 Performance: as scheduled on drawings.

2.3 LINT FILTERS

- .1 Manufacturers:
 - .1 Reversomatic LT180 and LT200.
 - .2 Fantech DBLT4W acceptable manufacturer.
- .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.
- .5 Roof Exhaust Fan:
 - .1 Secure roof exhausters with stainless steel lag screws to roof curb.
 - .2 Extend ducts to roof exhausters into roof curb. Counter flash duct to roof opening.
 - .3 Install motorized backdraft dampers on inlet to roof and wall exhausters.
- .6 Cabinet Ceiling Exhaust Fans:
 - .1 Support exhaust fans independently of ductwork.
 - .2 Provide backdraft dampers on outlet.
- .7 Dryer Exhaust:
 - .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 20 05 00 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Diffusers
- .2 Linear Diffusers and Grilles
- .3 Grilles and Registers
- .4 Critical Environments

1.4 REFERENCES

- .1 ADC 1062 - Air Distribution and Control Device Test Code.
- .2 AMCA 500-L – Laboratory Method of Testing Louvres for Ratings.
- .3 AMCA 500-D – Laboratory Method of Testing Dampers for Ratings.
- .4 ASHRAE 70 - Method of Testing the Performance of Air Outlets and Air Inlets
- .5 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- .6 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 ASHRAE 70.
- .2 Test and rate louvre performance to AMCA 500-L.
- .3 Test and rate damper performance to AMCA 500-D.

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;
 - a. Titus
 - b. Kreuger
 - c. Metalaire
 - d. Nailor
 - e. Carnes
 - f. Tuttle & Bailey

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 LINEAR SLOT DIFFUSER

- .1 Manufacturer's Reference: Price Model SDS
- .2 Type: extruded aluminum, linear slot with aerodynamic "ice-tong" pattern controller to provide 180 deg. pattern adjustment, left, right or vertical, and flow control with stable horizontal air pattern
- .3 Border: heavy extruded aluminum construction with extruded aluminum spacers and mitered end flanges, open ends, flush end caps or angle end caps and joiner strips as needed. Border shall be finished in B12 white powder coat.
- .4 Slots:
 - a. ½" (13mm) width and number of slots as scheduled.
 - b. ¾" (19mm) width and number of slots as scheduled.
 - c. 1" (25mm) width and number of slots as scheduled.
- .5 Frames: Type 7 for concealed mounting with flange frame in plaster or tile ceilings, Type 9A or 9B to integrate with ceiling suspension systems and type 15 to integrate with T-Bar ceiling systems.
- .6 Accessories: alignment strips, plaster frame spacers and metal blank-offs as required.
- .7 Plenums: Fibre Free insulated sloped shoulder plenums to suit ceiling type, Price model SDBI or SDAI.
- .8 Provide plenums with cable operated balancing damper, adjustable from face of diffuser to avoid access doors in drywall ceilings.

2.4 MAXIMUM SECURITY GRILLES - PERFORATED

- .1 Basis of Design: Price Model MSPG Series
- .2 Type: perforated face, maximum security grilles
- .3 Construction:
 - a. Face Plate:
3/16" (5mm) hot rolled steel.
 - b. Face Plate Pattern:
5/16" (8mm) diameter holes staggered 60° on 7/16" (11) centers.
 - c. Sleeve: length as required,
stitch welded seams, OR continuously welded seams,
bent out rear flange.
 - d. Sleeve Materials:
3/16" (5mm) hot rolled steel.
 - e. 4-Sided Mounting Frame: shipped loose for field welding or bolting
1" x 1" x 3/16" (25mm x 25mm x 5mm) hot rolled steel angle frame.
- .4 Fastening Methods:
3/4" x 3" (19 x 76) diameter masonry rods.
- .5 Dampers: opposed blade damper, front/rear operated,
cold rolled steel
- .6 Barrier Bars:
hot rolled steel bars on maximum 6" (152) vertical and 12" (305) horizontal centres, 1/2" (13), 3/4" (19), Wire Mesh: 10 gauge x 3/8" (10) clear opening steel wire mesh
- .7 Finish: painted with a powder coat process, white.

2.5 CEILING GRID CORE GRILLES 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.

2.6 CEILING GRID CORE GRILLES RETURN

- .1 Manufacturer's Reference: Price Model 80
- .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.

2.7 SIDEWALL RETURN/EXHAUST GRILLES

- .1 Manufacturer's Reference: Price Model 630D. Aluminium return grille with 45-degree deflection fixed louver type, blades spaced 3/4 in. (19mm) on center, blades parallel to long dimension, opposed blade volume control.
- .2 Mounting type: Flat standard border, no mounting frame, countersunk fastening.
- .3 Finish: Finish selection by Architect. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 and ASTM D714.

2.8 MAXIMUM SECURITY RETURN / EXHAUST GRILLES

- .1 Manufacturer's Reference: Price MSRRG
- .2 Thread resistant core.
- .3 Steel construction, 3/16" (5mm) hot rolled steel frame, louvers at 1" angle 45 degree deflection on 1/4 inch centers, 1-3/4" x 12 GA hot rolled steel bar mullions, opposed blade damper, powder coat finish.
- .4 Fastening: countersunk holes with #8 thread cutting tamper-proof screws into 0.047" (1mm) steel plate, drilled to accept screws.

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 Provide safety chains for ceiling mounted filter units and for diffusers 24" x 48" (600 x 1200mm) and larger.
- .7 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 20 05 00 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Louvres
- .2 Vents

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 Airolite
 - .1 Other acceptable manufacturers meeting specifications
 - .1 Construction Specialties
 - .2 Price
 - .3 Ventex/Alumavent
 - .4 McGill

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 6-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: Airolite K6776

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.
- .4 Fuel connection.
- .5 Flue Gas Venting.

1.4 REFERENCES

- .1 CSA
 - .1 CSA B51 Boiler, Pressure Vessel and Pressure Piping Code as adopted
 - .2 CSA B149.1 Natural Gas and Propane Installation Code as adopted.
- .2 American Gas Association
 - .1 AGA - Directory of Certified Appliances and Accessories.
 - .2 AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .3 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.
- .4 HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.
- .5 National Electrical Manufacturers Association
 - .1 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- .6 National Fire Protection Association
 - .1 NFPA 54 (AGA Z223.1) - National Fuel Gas Code.
 - .2 NFPA 58 - Liquefied Petroleum Gas Code.

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 CSA B149.1 Natural Gas and Propane Installation Code as adopted.
- .3 Conform to ASME SEC 4 and SEC 8D for boiler construction.
- .4 Units: CSA/CGA certified.
- .5 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 stainless steel 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: Lochinvar FTX
- .2 Other acceptable manufacturers;
 - .1 EnerPro Boiler
 - .2 Fulton
 - .3 Visseman
 - .4 Cleaver Brooks
 - .5 DiDietric

2.2 BOILERS – Lochinvar FTX

- .1 CONSTRUCTION
 - .1 General:
 - .1 Boiler shall be natural gas fired, fully condensing, and fire tube design. The boiler shall be factory-fabricated, factory-assembled, and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.
 - .2 Heat Exchanger:
 - .1 The heater exchanger shall bear the ASME “H” stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of a fully welded stainless steel and of fire tube design. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Cast iron, aluminum, or condensing copper tube boilers will not be accepted.
 - .3 Efficiency:
 - .1 Boilers shall have an AHRI certified minimum thermal efficiency of 97 percent.
 - .4 Condensate Collection Basin:
 - .1 Fully welded stainless steel and shall include a stainless steel combustion analyzer test port.
 - .5 Pressure Vessel:
 - .1 The pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The pressure vessel shall be designed for a single-pass water flow to limit the water side pressure drop.
 - .6 Burner:
 - .1 Natural gas, forced draft single burner premix design. The burner shall be high temperature stainless steel with a woven Fecralloy outer covering to provide modulating firing rates. The burner shall be capable of the stated gas train turndown

- without loss of combustion efficiency.
- .7 Blower:
 - .1 Boiler shall be equipped with a pulse width modulating blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation.
- .8 Gas Train:
 - .1 The boiler shall be supplied with a negative pressure regulation gas train and shall be capable of the following minimum turndowns: 10:1.
- .9 Ignition:
 - .1 Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- .10 Casing:
 - .1 Jacket: Heavy gauge primed and painted steel jacket with snap-in closures.
 - .2 Control Compartment Enclosures: NEMA 250, Type 1A.
 - .3 Insulation: Minimum ½ inch thick, mineral fiber insulation surrounding the heat exchanger.
 - .4 Combustion-Air Connections: Inlet and vent duct collars.
- .11 Characteristics and Capacities:
 - .1 Heating Medium: Hot water.
 - .2 Design Water Pressure Rating: 160 psi working pressure.
 - .3 Safety Relief Valve Setting: 50 psig
- .12 Safety Relief Valve:
 - .1 Size and Capacity: 50 lb.
 - .2 Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
- .13 Pressure Gage:
 - .1 Minimum 3-1/2 inch diameter. Gage shall have normal operating pressure about 50 percent of full range.
- .14 Drain Valves:
 - .1 Minimum NPS 3/4 or nozzle size with hose-end connection.
- .15 Condensate Neutralization Kit:
 - .1 Factory supplied condensate trap with condensate trip sensor, high-capacity condensate receiver prefilled with appropriate medium.
- .2 CONTROLS
 - .1 General:
 - .1 Refer to Division 25 Controls for coordination.
 - .2 Boiler controls shall feature a standard, factory installed multi-color graphic LCD screen display with navigation dial and includes the following standard features:
 - .2 Control Features:
 - .1 Con-X-Us capable: Boiler shall have the ability to communicate remotely using the optional Con-X-Us software via a wireless or Ethernet connection.
 - .2 Variable Speed Boiler Pump Control: Boiler may be programmed to send a 0-10V DC output signal to an ECM or VFD boiler pump to maintain a designed temperature rise across the heat exchanger.
 - .3 Outdoor air reset: Boiler shall calculate the set point using a field installed, factory supplied outdoor sensor and an adjustable reset curve.
 - .4 Pump exercise: Boiler shall energize any pump it controls for an adjustable time if the associated pump has been off for a time period of 24 hours.
 - .5 Pump control: Boiler shall have the ability to control the boiler pump, and system pump.
 - .6 Ramp delay: Boiler may be programmed to limit the firing rate based on six limits steps and six-time intervals.
 - .7 PC port connection: Boiler shall have a PC port allowing the connection of PC boiler software.
 - .8 Time clock: Boiler shall have an internal time clock with the ability to time and date stamp lock-out codes and maintain records of runtime.
 - .9 Maintenance reminder: Boiler shall have the ability to display a yellow colored,

- customizable maintenance notification screen. All notifications are adjustable by the installer based upon months of installation, hours of operation, and number of boiler cycles.
- .10 English Error codes: Boiler shall have a user interface that displays a red error screen with fault codes that are displayed in English and include a date and time stamp for ease of servicing.
 - .11 Anti-cycling control: Boiler shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter. The anti-cycling control parameter is adjustable by the installer.
 - .12 Space Heating Night setback: Boiler may be programmed to reduce the space heating temperature set point during a certain time of the day.
 - .13 Freeze protection: Boiler shall turn on the boiler and system pumps when the boiler water temperature falls below 45 degrees. When the boiler water temperature falls below 37 degrees the boiler will automatically turn on. Boiler and pumps will turn off when the boiler water temperature rises above 43 degrees.
 - .14 Isolation valve control: Boiler shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.
 - .15 Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, space heat run hours, domestic hot water run hours and ignition attempts. All data should be visible on the boiler screen.
- .3 Boiler Control Sequence:
- .1 The boiler shall have a built in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different btu inputs without utilization of an external controller. The factory installed; internal cascade controller shall include:
 - .1 Lead lag: The Control module shall allow only one boiler to fire at the beginning of a call for heat. Once the lead boiler is in full fire and the control calculates that additional heat is required it will call on an additional boiler as needed.
 - .2 Efficiency optimization: The Control module shall allow multiple boilers to simultaneously fire at minimum firing rate in lieu of Lead/Lag.
 - .3 Rotation of lead boiler: The Control module shall change the lead boiler every hour for the first 24 hours after initializing the Cascade. Following that, the leader will be changed once every 24 hours.
- .4 Boiler operating controls:
- .1 Set-Point Adjust: Set points shall be fully adjustable by the installer.
 - .2 Sequence of Operation: Factory installed controller to modulate burner firing rate to maintain system water temperature in response to call for heat.
 - .3 Sequence of Operation: Boiler shall come standard with outdoor reset control which will control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 10 deg F outside-air temperature, set supply-water temperature at 180 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 140 deg F.
- .5 Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation and include:
- .1 High Temperature Limit: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
 - .2 Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manually reset on the control interface.
 - .3 Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
 - .4 High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the

- control interface.
- .5 Blocked Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.
- .6 Low air pressure switch: Pressure switches shall prevent burner operation on low air pressure. Switch to be manually reset on the control interface.
- .6 Building Automation System (BAS / BMS) Interface:
 - .1 BMS integration with 0-10V DC input: The Control shall allow an option to Enable, and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.
 - .2 Factory installed Modbus gateway interface to enable building automation system to monitor, control, and display boiler status and alarms.
- .3 ELECTRICAL POWER
 - .1 Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
 - .2 Voltage: 120V / 1PH, Frequency: 60 Hz
- .4 VENTING
 - .1 Exhaust flue must be Category IV approved PVC, CPVC, PP or stainless-steel sealed vent material from one of the approved manufacturers listed in the Installation and Operation manual. Boilers exhaust vent length must be able to extend to 100 equivalent feet.
 - .2 Intake piping must be of approved material as listed in the Installation and Operations manual. Boilers intake pipe length must be able to extend to 100 equivalent feet.
 - .3 Boiler venting and intake piping configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual.
 - .4 Boiler shall come standard with a flue sensor to monitor and display flue gas temperature on factory provided LCD display.

2.3 BOILER CONTROLS - Lochinvar

- .1 The BOILER shall utilize a 24 VAC control circuit and components. The control system shall have a factory installed display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The BOILER shall be equipped with a temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 50 psi (standard); outlet water temperature sensor with a dual thermistor to verify accuracy; system supply water temperature sensor; outdoor air sensor, flue temperature sensor with dual thermistor to verify accuracy; low water cut off with manual reset, blocked drain switch and a condensate trap for the heat exchanger condensate drain.
- .2 The BOILER shall feature the "SMART SYSTEM™" control which is standard and factory installed with 128 x 128 resolution display, password security, outdoor air reset, pump delay with freeze protection, pump exercise, ramp delay featuring six steps, domestic hot water prioritization with limiting capabilities, USB drive for simple uploading of parameters and a PC port connection for connection to a local computer for programming and trending. A secondary operating control that is field mounted outside or inside the appliance is not acceptable. The BOILER shall have alarm contacts for any failure, runtime contacts and data logging of runtime at given modulation rates, ignition attempts and ignition failures. The BOILER shall have a built-in "Cascade" with leader redundancy to sequence and rotate while maintaining modulation of up to eight boilers of different Btu inputs without utilization of an external controller. The internal "Cascade" function shall be capable of lead-lag, efficiency optimization, front-end loading, and rotation of lead boiler every 24 hours. The BOILER shall be capable of remote communication via optional CON-X-US™ Remote Connectivity with the capability of historical trending and sending text message or email alerts to notify the caretaker of a boiler alarm and remote programming of onboard boiler control. The BOILER shall be capable of controlling an isolation valve (offered by manufacturer) during heating operation and rotation of open valves in standby operation for full flow applications. The control must have optional capability to communicate via Modbus protocol with a minimum of 46 readable points. The BOILER shall have a gateway device which will allow integration with BAS through BACnet protocols.
- .3 The "SMART SYSTEM™" control shall increase fan speed to boost flame signal when a weak flame signal is detected during normal operation. A 0-10 VDC output signal shall control a variable speed

boiler pump to keep a fixed Delta T across the boiler regardless of the modulation rate. The BOILER shall have the capability to receive a 0-10 VDC input signal from a variable speed system pump to anticipate changes in system heat load in order to prevent flow related issues such as erratic temperature cycling.

3 EXECUTION

3.1 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Install to Ontario Gas Utilization Code.
- .3 Install boiler on concrete housekeeping base, sized minimum 4" (100 mm) larger than boiler base.
- .4 Provide connection of natural gas service to each boiler. Each boiler shall require a minimum gas pressure of 4" W.C. to 14" W.C.
- .5 Provide piping connections and accessories. Each boiler shall have individually isolating shutoff valves for service and maintenance.
- .6 Pipe relief valves to nearest floor drain.
- .7 Install circulator and expansion tank on boiler.
- .8 Provide for connection to electrical service
- .9 Install all devices provided by boiler manufacturer for field installation for complete working system,
- .10 Install all control wiring (unless specifically covered under Division 25) for complete working system including interconnection of multiple boilers and boiler/pump interconnections as required.
- .11 Assemble and install boiler trim.
- .12 Install electrical and control devices furnished with boiler but not specified to be factory mounted.
- .13 Install control wiring to field-mounted electrical and control devices.
- .14 Install piping adjacent to boiler to allow service and maintenance.
- .15 Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of equipment
- .16 connection. Provide a reducer if required.
- .17 Install piping from equipment drain connection to nearest floor drain complete with condenser neutralizer. Piping shall be at least full size of connection. Provide an isolation valve if required.

3.2 VENTING

- .1 Exhaust Flue must be category IV approved CPVC or stainless steel sealed vent material from one of the approved manufacturers listed in the Installation and Operation manual. Boiler exhaust vent length must be able to extend to 100 equivalent feet.
- .2 Intake piping must be of approved material as listed in the Installation and Operations manual. Boiler intake pipe length must be able to extend to 100 equivalent feet.
- .3 Boiler venting and intake pipe configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual.
- .4 Boiler must come standard with a flue sensor to monitor and display flue gas temperature on factory provided LCD/LED display.
- .5 Refer to manufacturer's Installation and Operations manual for detailed venting instructions and approved venting manufacturers.

3.3 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.

3.4 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 REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

- .1 Section 20 05 00 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Shell and Tube Type Heat Exchangers.
- .2 Stainless Steel Shell and Coil Heat Exchanger
- .3 Plate Type Heat Exchangers.
- .4 Plate and Frame Type Heat Exchangers –Package
- .5 Shell and Tube Type Heat Exchangers-Package
- .6 Accessories and trim.

1.4 REFERENCES

- .1 CAN/CSA B51 Boiler, Pressure Vessel and Pressure Piping Code.
- .2 ASME Section VIII - Boilers and Pressure Vessel Code.
- .3 AHRI Standard 400 Performance Rating of Liquid to Liquid Heat Exchangers.
- .4 AHRI Standard 401 Performance Rating of Liquid to Liquid Heat Exchangers.

1.5 SUBMITTALS

- .1 Product Data: Provide data with dimensions, locations, and size of tapings and performance data.
- .2 Shop Drawings: Indicate dimensions, locations, and size of tapings and performance data.
- .3 Design Data: Indicate in sufficient detail to verify that heat exchangers meet or exceed specified requirements.
- .4 Test Reports: Indicate tube bundle pressure tests.
- .5 Manufacturer's Instructions: Indicate installation and support requirements.
- .6 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 REGULATORY REQUIREMENTS

- .1 Conform to CSA B51 Boiler, Pressure Vessel and Pressure Piping Code.
- .2 Conform to ASME Boilers and Pressure Vessels Code, Section VIII for manufacture of tubular heat exchangers and heat exchanger shells.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Transport, handle, store, and protect products.
- .2 Protect internals from entry of foreign material by temporary caps on flanged openings.

1.8 WARRANTY

- .1 Provide five (5) year manufacturer warranty for heat exchangers.

1.9 EXTRA MATERIALS

- .1 Provide two sets of replacement gaskets.
- .2 Provide one set of wrenches for disassembly of plate type heat exchangers.

2 PRODUCTS

2.1 PLATE AND FRAME TYPE HEAT EXCHANGER

- .1 Acceptable Manufacturers:
 - .1 Alpha Laval.
 - .2 Armstrong.
 - .3 Bell & Gossett-Xylem
 - .4 Graham
 - .5 Taco
 - .6 AIC- Advanced Industrial Components
- .2 A plate heat exchanger consisting of a pack of gasketed corrugated metal plates, provided with ports for the passage of fluids between which heat is transferred, and clamped between a stationary frame and a pressure plate by a series of threaded lateral bolts, and complete with top and bottom carrying bar, and end support column.
- .3 Frames: Carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.
- .4 Plate Materials: Type 316 stainless steel.
- .5 Gasket Material: EPDM
- .6 Design Pressure: suitable to 150 psi (1 Mpa).
- .7 Nozzles: 125 psi (860 kPa) rated lined flange type.
- .8 Performance: as scheduled on drawings

2.2 PLATE AND FRAME TYPE HEAT EXCHANGER - PACKAGED

- .1 Acceptable Manufacturers:
 - .1 Spirax Sarco
 - .2 Bell & Gossett-Xylem
 - .3 Armstrong
- .2 Quickheat system
 - .1 Provide Spirax Sarco QuickHeat engineered system, Model QHPM17Z02400. The system shall include two Plate and Shell Heat Exchangers (PSHE) per model numbers described in the schedule. Each PSHE shall be designed for 100% duty, per conditions described in the schedule. Each PSHE will be supplied with Spirax Sarco M40 ISO ball valves for complete steam and condensate isolation.
 - .2 The primary steam side of the system shall include two temperature control valves, one high limit steam cut off valve and four M ISO ball valves for control valve isolation. The temperature control valves shall be Spirax Sarco Series LEA43 and shall be complete with Spirax Sarco Series EL5600 electric actuators.
 - .3 The condensate side of the system shall include Spirax Sarco duplex APT14HC condensate removal package completes with two Series APT14HC Auto Pump Traps, carbon steel high-capacity condensate receiver, motive steam sub-assemblies, check valves and isolation valves.
 - .4 The secondary side of the system shall include four Series 4300 Split Coupled Vertical In-line centrifugal pumps and on E series Close Coupled Dry Motor Circulator. Each pump shall be supplied with Flo-Trex valve and Suction Guide. The pump control panel(s), pump starters and control signal to the pumps shall be supplies by heat exchanger manufacturer.
 - .5 The QuickHeat system shall be supplied as a steam side-controlled unit using electrically operated steam temperature control valves on the inlet to the heat exchangers. Condensate will be able to be lifted to condensate lines located higher that the unit. Provide electric high limit shut off valve to shut steam supply in case of excess temperature. All control valves to be monitored and controlled through the temperature and pressure control panel that is supplied with package.
 - .6 Space Limitations: The Skid Package on the QuickHeat system along with the pumps and accessories shall have a maximum footprint of a regular space of 10'-10" by 3'-3" with a vertical limit of 9'-0". The various components including the Heat exchanger shall be accessible for regular maintenance within the footprint, without disrupting the hot water supply.
 - .7 Heat Exchanger shall be fully welded Plate & Shell unit complete with tubular carbon steel shell designed to ASME Section VIII Division I. Unit shall be supplied with a pack of circular

- fully welded gasket-free AISI 316L stainless steel plates for efficient heat transfer. Unit shall come with end plate supports.
- .8 The exchanger shall be single pass counter current flow design to accommodate thermal duties.
 - .9 Design Pressure; 150 PSIG, flanged connections
 - .10 Capacity: Refer to Heat Exchanger Schedule

2.3 CONTROLS

- .1 Heat transfer system shall provide specified temperature set point control when supplied with saturated steam. Temperature control to be achieved by means of an integral electronic temperature controller and temperature sensor, which provides a modulated control signal to the skid mounted steam control valve to be an industrial grade single seat, cage guide globe-style valve with a characterized plug, electrically controlled. High temperature shut-off, electric actuated ball valve shall be incorporated in the package to protect against excessively high temperature exchanger until satisfactory water temperature has been re-established. All control equipment is to be pre-wired to the integral temperature controller. All components to be factory installed and wired if required and ready to connect to building services. Supply voltage is 110/1/60. Control enclosures and wiring to be minimum NEMA 4. Integral temperature controller to have local digital temperature display and be able to function as both a standard alone controller and receiver a 4-20mA retransmit signal to indicate heat exchanger discharge temperature.
- .2 Accurate and precise control of outgoing temperature shall be achieved by providing a Model SX-77 multifunction process controller of outgoing with high-level communications. The controller shall have initial fuzzy tuning and continuous adaptive tuning capability. Unit shall have a RS4845 serial communication port at 19200 baud Modbus/Jbus. Controls contractor shall provide 24vdc auxiliary power for external transmitter supply and a power supply of 100-240Vac 50/60Hz. Controls shall pick up secondary water temperature signals for display at BMS system screen.

2.4 CONDENSATE REMOVAL

- .1 Effective condensate removal for heat exchanger under all varying operating loads is to be provided via an automatic pressure pump/trap combination complete with inlet and outlet check valves that are capable of returning condensate under 'no pressure to vacuum conditions' from the heat exchanger and capable of working with a minimum filling head of 8" (200mm). Heat exchanger package is to be piped to provide closed-loop condensate return complete with integral condensate reservoir. System design must be capable of discharging condensate below the saturated steam flash point at atmospheric pressure all items are to be factory mounted and piped if requested. All pipe work is to be correctly sized for the application and fabricated using modern welding techniques, with approved welders and weld procedures to meet applicable ASME/CSA standards and local codes. Flanged products are to be used where possible.

2.5 FLO-TREX VALVES

- .1 Furnish and install on the discharge side of each pump and Armstrong Model FTV Flo-Trex Combination Valve. Each valve is to incorporate the following three functions in one body: Tight shut-off, spring-closure type silent non-slam check and effective throttling with flow measurements capability. The body shall have (2) 1/4" NPT connections on each side of the valve seat. Two connections to have brass pressure and temperature metering ports, with Nordel check valved and gasketed caps. Two other connections to be supplied with brass drain plugs. Metering ports are to be interchangeable with drain ports to allow for measurement flexibility when installed in tight locations. The valve disc shall be bronze plug & disc type with high impact engineered resin seat to ensure tight shut-off and silent check operation. The valve stem shall be stainless steel with flat surfaces provided for adjustment with open-end wrench. The valve shall be selected and installed in accordance with the manufacturer's instructions and be suitable for the pressure and temperature specified.

2.6 SUCTION GUIDES

- .1 Furnish and install on the suction of each pump an Armstrong Suction Guide, with Outlet Flow

Stabilizing Guide Vanes, removable Stainless Steel Strainer and Fine Mesh Start-up Strainer. (For 150 psig flanged pipe) Supply valve with Cast Iron body with 125 psig flanged ports. The mechanical contractor shall inspect the strainer after a short running period. (24 Hour Maximum). Space shall be provided for removal of the Strainer and connection of a Blow-down Valve.

3 EXECUTION

3.1 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Install to permit removal of tube bundle with minimum disturbance to installed equipment and piping.
- .3 Support heat exchangers on welded steel pipe and angle floor stand on concrete housekeeping pad.
- .4 Pitch shell to completely drain condensate.
- .5 Pipe relief valves to nearest floor drain.
- .6 Pipe drain valves to nearest floor drain.

3.2 PLATE TYPE HEAT EXCHANGER TRIM

- .1 Install heat exchangers where indicated.
- .2 Install all necessary structural supports.
- .3 Make all necessary piping connections.
- .4 Install pressure relief valve in the outlet pipe of heat exchanger prior to any shut-off valves. Provide and install relief discharge pipe to nearest funnel floor drain or service sink.

3.3 WATER TO WATER HEAT EXCHANGER TRIM

- .1 Water Inlets and Outlets: Thermometer wells, pressure gauge tappings.
- .2 Heated Water Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure and temperature relief valve, valved drain; refer to Section 23 05 20.

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 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Ductless Split Air Conditioning Systems.

1.4 REFERENCES

- .1 Local and District By-Laws, Regulations and Published Engineering Standards.
- .2 CAN/CSA - B52 Mechanical Refrigeration Code.
- .3 American Society Heating Refrigeration Air Conditioning Engineers
 - .1 ASHRAE 15 – Safety standard for Refrigeration Systems
- .4 Underwriters Laboratories
 - .1 UL 207 – Refrigeration containing components and accessories, non-electrical.
 - .2 UL 303 – Refrigeration and Air Conditioning and Compressor Units

1.5 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide catalogue data indicating rated capacity, dimensions, duct and service connections, electric nameplate data and wiring diagrams.
- .2 Shop Drawings: Indicate layout of system and components. Indicate wiring diagrams showing all interconnections), weight, performance details.
- .3 Manufacturer's Instructions: Indicate installation instructions and recommendations.
- .4 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- .5 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. The units shall be listed by CSA, cETL, cUL or another approved testing agency, and bear the appropriate label.
- .2 All wiring shall be in accordance with the Canadian Electric Code (C.E.C)
- .3 The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001 which is set of standards applying to environmental protection set by the International Standard Organization (ISO)
- .4 All units must meet or exceed the the ASHRAE 90.1 efficiency requirements. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340, 360, 1230 and ISO Standard 13256-1.
- .5 A full charge of R-410A for the condensing unit shall be provided in the condensing unit.
- .6 The systems shall be designed by a certified manufacturer designer and installed by a contractor that has successfully completed the manufacturer's service course and shall be verified with a completed commissioning report submitted to and approved by the manufacturer.
- .7 Manufacturer shall have a minimum of five years of HVAC VRF experience in the Canadian market.
- .8 The system shall be installed by a contractor with the extensive installation experience and service training. The mandatory contractor service and install training should be performed by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Unit shall be stored and handled according to the manufacturer's recommendation. In addition the compressor shall have a manufacturer's limited warranty for a period of seven (7) years from date of installation.

1.8 WARRANTY

- .1 The units shall be covered by an extended manufacturer's limited warranty for a period of five (5) years from date of installation.
- .2 The compressor shall have a manufacturer's limited warranty for a period of seven (7) years from date of installation.

2 PRODUCTS

2.1 AIR CONDITIONING UNIT - SPLIT SYSTEM

- .1 Manufacturer: Mitsubishi model indicated
- .2 Approved equals (subject to shop drawing review):
 - .1 LG
 - .2 Daikin
 - .3 Hitachi
 - .4 Samsung
- .3 The following are required to be included in the submission of other Acceptable Manufacturers:
 - .1 Revised piping drawings according to manufacturer's system, showing pipe sizes, controllers and condensing unit locations.
 - .2 Any additional requirements to the existing design example: electric service switches etc.
 - .3 A list of equipment with their electric requirements.
- .4 General:
 - .1 CSA or Ontario Hydro Inspection approved, UL or ULC tested, and AHRI rated, and factory assembled with all controls installed, piped and wired. Refer to Mechanical-electrical Schedule for electrical characteristics.
- .5 Fan Coil Unit (wall mounted)
 - .1 General: unit shall be suitable for use as indicated. Unit shall be supplied complete with cabinet, evaporator coil, drain pan, refrigerant line connections, blower cooling relay, expansion valve kit, blower, disconnect switch, and filter section.
 - .2 Capacities and Performance as shown on drawings.
- .6 Condensing Unit
 - .1 General: constructed with heavy gauge enameled steel cabinet, complete with control box, direct drive outdoor fan with inverter driven motor with permanently lubricated bearings, inverted driven compressor with internal thermal overload, outdoor coils, suction line accumulator, expansion valve, crankcase thermostat, low ambient switch and kit (design to -40C), high pressure switch, start controls, Hi-capacity two drier-check valve system, refrigerant line connections, electrical inlets and service valves, weatherproof disconnect switch, and insulated refrigerant line kit. (Less refrigerant).
 - .2 Completely weather proof and corrosion resistant with baked enamel finish.
 - .3 Capacities and performance as shown on drawings.
- .7 Equipment Warranty:
 - .1 The compressor shall have a limited warranty for a full five (5) years. All other components shall have a limited Warranty for one (1) year.
- .8 Start Up:
 - .1 Provide the service of certified manufacturer's representative during start-up and owner's instruction.
- .9 Controls
 - .1 This unit shall be supplied with wired individual zone controller provided by manufacturer to perform functions necessary to operate the system. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8-degree F dead band from set point.
 - .2 The unit shall be supplied with Interface Adapter for integration with Building Automation

System.

- .10 Accessories:
 - .1 Wind screens (to be field installed) and roof support stand to raise unit above local snow levels.

3 EXECUTION

3.1 AIR CONDITIONING - SPLIT SYSTEM

- .1 Install indoor unit in accordance with manufacturer's installation instructions. Make all duct and piping connections necessary.
- .2 Install outdoor unit plumb and level on concrete pad or wall mounted as required, making all necessary piping connections.
- .3 Install refrigerant line kits in accordance with manufacturer's installation instructions.
- .4 Refrigeration Equipment: prepare system for start-up by having manufacturer's field engineer or factory trained representative supervise testing and charging of machines.
- .5 Testing:
 - .1 Provide sufficient refrigerant, dry nitrogen and refrigeration oil for pressure and operational testing under manufacturer's supervision.
 - .2 Prior to testing ensure that system is complete. Protect relief valves during test procedure. After completion of test, reconnect and make good piping connections and leak test entire system.
- .6 All pipework (suction and liquid lines) to be insulated with slip on close cell elastomeric pipe insulation (as manufactured by Armaflex or equal and approved) having a wall thickness of not less than ½" (13mm).
- .7 A condensate line shall be installed to each fan coil unit. This shall be installed and insulated all as per the standard specification. Minimum size of condensate pipes to be 1" (25mm) copper insulated and pumped from each fan coil/cassette to drains as shown in the drawings.
- .8 Power wiring under Division 26.
- .9 Control wiring under Division 25.

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 29 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

- .1 Variable Refrigerant Flow Systems.

1.4 REFERENCES

- .1 Local and District By-Laws, Regulations and Published Engineering Standards.
- .2 CAN/CSA - B52 Mechanical Refrigeration Code.
- .3 American Society Heating Refrigeration and Air Conditioning Engineers
 - .1 ASHRAE 15 – Safety standard for Refrigeration Systems
- .4 Underwriters Laboratories
 - .1 UL 207 – Refrigeration containing components and accessories, non-electrical.
 - .2 UL 303 – Refrigeration and Air Conditioning and Compressor Units

1.5 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide catalogue data indicating rated capacity, dimensions, duct and service connections, electric nameplate data and wiring diagrams.
- .2 Shop Drawings: Indicate layout of system and components. Shop drawings shall include calculations by manufacturer to confirm refrigerant volume does not exceed limits as described by CSA B52 (current version).
- .3 Manufacturer's Instructions: Indicate installation instructions and recommendations.
- .4 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- .5 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- .6 The contractor shall submit shop drawings prepared and sealed by Professional Engineer experienced in designing VRF system and licensed in Ontario.
- .7 Within ten days from awarded contract the Contractor shall submit 2 sets of VRF system shop drawings and specifications to T.S.S.A. for review.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- .2 The units shall be listed by CSA, cETL, cUL or another approved testing agency, and bear the appropriate label.
- .3 All wiring shall be in accordance with the Canadian Electric Code (C.E.C)
- .4 The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001 which is set of standards applying to environmental protection set by the International Standard Organization (ISO)
- .5 All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340, 360, 1230 and ISO Standard 13256-1.
- .6 A full charge of R-410A for the condensing unit shall be provided in the condensing unit.
- .7 The systems shall be designed by a certified manufacturer designer and installed by a contractor that has successfully completed the manufacturer's service course and shall be verified with a completed commissioning report submitted to and approved by the manufacturer.

- .8 Manufacturer shall have a minimum of five years of HVAC VRF experience in the Canadian market.
- .9 The system shall be installed by a contractor with the extensive installation experience and service training. The mandatory contractor service and install training should be performed by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Unit shall be stored and handled according to the manufacturer's recommendation. In addition the compressor shall have a manufacturer's limited warranty for a period of seven (7) years from date of installation.

1.8 WARRANTY

- .1 The units shall be covered by an extended manufacturer's limited warranty for a period of five (5) years from date of installation.
- .2 The compressor shall have a manufacturer's limited warranty for a period of seven (7) years from date of installation.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Basis of design: Mitsubishi
- .2 Acceptable alternate Manufactures upon review of submission
 - .1 Daikin
 - .2 LG
- .3 The following are required to be included in the submission of other Acceptable Manufacturers:
 - .1 Revised piping drawings according to manufacturer's system, showing pipe sizes, controllers and condensing unit locations.
 - .2 Any additional requirements to the design ex. electric service switches etc.
 - .3 A list of equipment with their electric requirements.
 - .4 Calculations by supplier to confirm refrigerant volume does not exceed limits CSA B52 (current version).
 - .5 Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, core operational features, sound levels, etc.

2.2 R2-SERIES Outdoor Unit

- .1 General:
 - .1 The R2-Series PURY outdoor unit shall be used specifically with CITY MULTI VRF components. The PURY outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
 - .2 The model nomenclature and unit requirements are shown below. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor.
 - .3 Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 64 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned while in night mode operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
 - .4 Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated in accordance with the installation manual.
 - .5 There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.
 - .6 Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.

- .7 The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
- .8 The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
- .9 The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-2625 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
- .10 The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperatures or cooling mode down to 23°F ambient temperatures, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
- .11 The outdoor unit shall be capable of operating in cooling mode down to -30°F with manufacturer supplied/installed low ambient kit.
- .12 Manufacturer supplied low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.
- .13 Manufacturer supplied low ambient kit shall be listed by Electrical Laboratories (cETL) and bear the cETL label.
- .14 Manufacturer supplied low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.
- .15 The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- .16 The outdoor unit shall be provided with a manufacturer supplied 20-gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.
- .17 Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend "no or reduced heating" periods shall not be allowed.
- .2 Unit Cabinet:
 - .1 The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
- .3 Fan:
 - .1 Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
 - .1 All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
 - .2 All fan motors shall be mounted for quiet operation.
 - .3 All fans shall be provided with a raised guard to prevent contact with moving parts.
 - .4 The outdoor unit shall have vertical discharge airflow.
- .4 Refrigerant
 - .1 R410A refrigerant shall be required for PURY-P-T/Y(S)KMU-A outdoor unit systems.
 - .2 Polyolester (POE) oil shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
- .5 Coil:
 - .1 The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
 - .2 The coil fins shall have a factory applied corrosion resistant blue-fin finish.
 - .3 The coil shall be protected with an integral metal guard.
 - .4 Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
 - .5 The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

- .6 Base-pan Heater:
 - .1 Each outdoor unit module shall be equipped with a base-pan heater. Base-pan heater shall activate only when compressor is operating in heating mode at an outdoor ambient temperature of 39F or below. If an alternate manufacturer is selected, any additional material, cost, and labor to meet base-pan heater condition and performance shall be incurred by the contractor.
- .7 Compressor:
 - .1 Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
 - .2 A crankcase heater(s) shall be factory mounted on the compressor(s).
 - .3 The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-5% of rated capacity, depending upon unit size.
 - .4 The compressor will be equipped with an internal thermal overload.
 - .5 The compressor shall be mounted to avoid the transmission of vibration.
 - .6 Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.
- .8 Controls:
 - .1 The outdoor unit shall have the capability of up to 8 levels of demand control for each refrigerant system.
- .9 Electrical:
 - .1 The outdoor unit electrical power shall be 575volts, 3-phase, 60 hertz.
 - .2 The outdoor unit shall be controlled by integral microprocessors.
 - .3 The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.3 BRANCH CIRCUIT (BC) CONTROLLERS FOR R2-SERIES SYSTEMS

- .1 General:
 - .1 The BC (Branch Circuit) Controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices with no subcooling risk bubbles in liquid supplied to LEV and are not allowed.
 - .2 The BC (Branch Circuit) Controllers shall be specifically used with R410A R2-Series systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.
- .2 BC Unit Cabinet:
 - .1 The casing shall be fabricated of galvanized steel.
 - .2 Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
 - .3 The unit shall house two tube-in-tube heat exchangers.
- .3 Refrigerant
 - .1 R32 refrigerant shall be required.
- .4 Refrigerant valves:
 - .1 The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
 - .2 Each branch shall have multiple two-position valves to control refrigerant flow.
 - .3 Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.

- .4 Linear electronic expansion valves shall be used to control the variable refrigerant flow.
- .5 Future Use
 - .1 Each VRF system shall include at least one (1) unused branches or branch devices for future use. Branches shall be fully installed & wired in central location with capped service shutoff valve & service port.
- .6 Integral Drain Pan:
 - .1 An Integral drain pan and drain shall be provided.
- .7 Electrical:
 - .1 The unit electrical power shall be 208volts, 1 phase, 60 Hertz.
 - .2 The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz).
 - .3 The BC Controller shall be controlled by integral microprocessors.
 - .4 The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.4 PEFY-NMAU (CEILING-CONCEALED DUCTED HIGH STATIC OPTION) INDOOR UNIT

- .1 General:
 - .1 The PEFY shall be a ceiling-concealed ducted indoor fan coil design that mounts above the ceiling with a 2-position, field adjustable return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The PEFY shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PEFY shall support individual control using M-NET DDC controllers.
- .2 Indoor Unit
 - .1 The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- .3 Unit Cabinet:
 - .1 The unit shall be, ceiling-concealed, ducted.
 - .2 The cabinet panel shall have provisions for a field installed filtered outside air intake.
- .4 Fan:
 - .1 PEFY-NMAU models shall feature external static pressure settings from 0.30 to 0.80 in. WG.
 - .2 The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.
 - .3 The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
 - .4 The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function.
 - .5 The indoor unit shall have a ducted air outlet system and ducted return air system.
- .5 Filter:
 - .1 Return air shall be filtered by means of a standard factory installed return air filter.
 - .2 Optional return filter box (rear or bottom placement) with high-efficiency filter shall be available for all PEFY indoor units.
- .6 Coil:
 - .1 The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - .2 The tubing shall have inner grooves for high efficiency heat exchange.
 - .3 All tube joints shall be brazed with phos-copper or silver alloy.
 - .4 The coils shall be pressure tested at the factory.
 - .5 A condensate pan and drain shall be provided under the coil.
 - .6 The condensate shall be gravity drained from the fan coil.
 - .7 Both refrigerant lines to the PEFY indoor units shall be insulated in accordance with the installation manual.
- .7 Electrical:
 - .1 The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
 - .2 The system shall be capable of satisfactory operation within voltage limits of 187-228 volts

- (208V/60Hz).
- .8 Controls:
- .1 This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system. Please refer to Part 5 of this guide specification for details on controllers and other control options.
 - .2 Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
 - .3 Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
 - .4 Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
 - .5 Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.5 CONTROLS

- .1 General:
- .1 The manufacturer's control system shall be capable of supporting remote controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.
 - .2 The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
 - .3 System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.
 - .4 Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
 - .5 System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.
 - .6 Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.
 - .7 System shall be capable of email generation for remote alarm annunciation.
 - .8 Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in controls system configuration and operation. The representative shall provide proof of certification for Training and/or Hands-On Training indicating successful completion of no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.
- .2 Electrical Characteristics: The CMCN shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus
- .1 Wiring:
- 1. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the controller(s) (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
 - 2. Control wiring for the remote controller shall be from the remote controller to the first associated indoor unit connection. The remote controller shall be assigned a network address.
 - 3. Control wiring for the remote controllers shall be from the remote controller (receiver) to the first associated indoor unit then to the remaining associated indoor units in a daisy chain configuration.

4. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web-based interface), to the power supply.
 5. The centralized controllers shall be capable of being networked with other centralized controllers for centralized control.
 6. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire.
 7. Network wiring shall be CAT-5 with RJ-45 connection.
- .3 Controls Network
- .1 The controls network consists of remote controllers, centralized controllers, and/or integrated web-based interface communicating over a high-speed communication bus. The controls network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces.
 - .2 Acceptable Product: Mitsubishi City Multi Controls Network
- .4 Remote Controllers
- .1 The remote controller shall be capable of controlling up to 16 indoor units. The remote controller shall be approximately 5.5" x 5" in size and white in color with an auto-timeout touch screen LCD display. The Smart ME Remote Controller shall support a selection from multiple languages (English, Spanish or French) for display information. The controller supports temperature display selection of Fahrenheit or Celsius. The remote controller shall control the following grouped operations: On/Off, Operation Mode (cool, heat, auto*, dry, fan and setback (Simultaneous Heating and Cooling only)), temperature set point, fan speed setting, and airflow direction setting. The remote controller shall support timer settings of on/off/temperature up to 8 times in a day in 5-minute increments. The remote controller shall support an Auto Off timer. The remote controller shall be able to limit the set temperature range from the remote controller, or via a PC through a licensed unit. Also, the temperature range can be set from a touch screen panel. The room temperature shall be sensed at either the remote controller or the indoor unit dependent on the indoor unit dipswitch setting. The remote controller shall display a four-digit error code in the event of system abnormality or error.
 - .2 The remote controller shall only be used in same group with other remote controllers with a maximum of two remote controllers per group.
 - .3 The remote controller shall require manual addressing using rotary dial switch to the communication bus. The remote controller shall connect using two-wire, stranded, non-polar control wire to connection terminal on the indoor unit.
 - .4 Acceptable Product: Mitsubishi Smart ME Remote Controller
- .5 BACnet® Interface
- .1 The interface shall be compliant with BACnet® Protocol (ANSI/ASHRAE 135-2004) and be Certified by the (BTL) BACnet® Testing Laboratories. The BACnet® interface shall support BACnet Broadcast Management (BBMD). The BACnet® interface shall support a maximum of 50 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.
 - .2 Acceptable Product: Mitsubishi Electric Cooling & Heating BACnet® interface AE-200
- .6 System Integration: The system shall be capable of supporting integration with Building Management Systems (BMS).

2.6 CONTROLS NETWORK

- .1 Overview: The Controls Network (CN) shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web-based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®
- .2 Electrical Characteristics
 - .1 General: The CN shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus.
 - .2 Wiring: Control wiring shall be installed in a system daisy chain configuration from indoor unit to ME remote controller to indoor unit, to the BC controller (main and subs, if applicable) and

- to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit. Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply.
- .3 Wiring type: Wiring shall be 2-conductor (16 AWG or 18 AWG), twisted shielded pair, stranded wire. Network wiring shall be CAT-5e with RJ-45 connection.
- .4 Controls Network: The Controls Network (CN) consists of remote controllers, schedule timers, system controllers, centralized controllers, and/or integrated web-based interface communicating over a high-speed communication bus. The Controls Network shall support operation monitoring, scheduling, error email distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CN System.
- .3 Remote Controllers
The Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group from this compact 5" x 5" (approximate) wall-mounted controller. The Remote Controller shall be capable of connecting anywhere on the communication bus and shall not require being physically located in the same room as the indoor unit(s) under its control. The Remote Controller shall control the following grouped operation for up to sixteen indoor units collectively: On/Off, Operation Mode (cool, heat, auto (R2-Series only), dry, and fan), temperature setting, fan speed setting, and airflow direction setting. The Remote Controller shall have three timer options: one on/off setting defined for one day, repeated daily timer, and auto-off timer function. The Remote Controller shall be able to limit the set temperature range from the Remote Controller and via a PC through a licensed AG-150A/GB-50A. The room temperature shall be sensed at either the Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Remote Controller shall display a four-digit error code in the event of system abnormality/error. The Remote Controller shall only be used in same group with other Remote Controllers with a maximum of two Remote Controllers per group. The Remote Controller shall require manual addressing using rotary dial switch to the communication bus. The Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB5 connection terminal on the indoor unit.
- .4 Input/Output (IO) Boards:
- .5 Central Controller: The Central controller shall have the capacity to control up to 50 indoor units/groups up to a maximum of 150 indoor units with expansion controllers. The centralized controller of the AG-150A combines Web function (optional), which enable the air conditioner system management on a PC browse screen. The system management can be undertaken via standard telephone line or internet connection. Working in tandem with centralized control software the TG-2000A and/or PLC can offer functions such as "charging", "Peak-cut", "Energy Saving", "General Equipment Management", "Scheduling" etc. One AG-150A can control a maximum of 50 indoor units (including LOSSNAY). The integrated centralized control software TG-2000 A can manage 40 AG-150A's, therefore controlling a maximum of 2000 indoor units including LOSSNAY. Utilizing the AG-150A's Web functions, alarm email containing address and error code can be sent to appointed email addresses upon any fault condition identified in the air-conditioning system. The AG-150A features a 9" wide color LCD touch panel. The settings can be adjusted by touching the corresponding icons on the LCD display.
- .7 Expansion Controllers: In applications where the AG-150 Centralized Controller is serving in excess of quantity 50 remote indoor units/groups quantity 1 expansion controller is required for each additional set of quantity 50 remote indoor units/groups. Make reference to the associated installation manuals for further technical application details.
- .8 BACNET Interface: The HVAC BACNET interface, shall support up to fifty indoor units with a variety of network variables on a per indoor unit basis. Input variables include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, and filter sign reset. Output variables include, but are not limited to, model size, alarm state, error code, and error address.
- .9 Power Supply: The power supply shall supply 24VDC (TB 3) for the AG-150 centralized controller and 22 - 30 VDC (TB 2) voltage for the-NET central control transmission. The power supply can power a maximum of one AG-150 centralized controller and is not suitable for utilization with the G-50A controller formats. Please see the following table for a summary of the quantity of controllers which can be served by the power supply:
- .1 Centralized Controller: AG-150 = 1 unit, G-50A = NA, GB-50A = 1 unit

- .2 Other system Controllers: On/OFF Remote controller PAC-YT40ANRA = 5 units, PACSF44SRA- System Remote and PAC-YT34STA - Schedule Timer = 10 units.
- .3 Remote Controllers: ME Remote ConPAR-F27MEA LOSSNAY RM PZ-52SF = 24 units.
The power supply module shall be installed in an internal environment a which has a temperature operating range -10 to 55°C and relative humidity range of 30 - 90% without any risk of condensation. The unit shall be rated for a 120/1/60 or 208/1/60 incoming power supply.
- .10 Control Wiring: The contractor shall be responsible for the interconnecting control wiring between the indoor and outdoor units and control wiring between remote controllers, centralized control, and relevant components. This work shall be co-ordinated with the Electrical / Controls Contractor for the routing and trunking of the cables. All control wiring is to be carried out in 2 core 16 AWG shielded cabling with colour coding and tagged with ID number at 10 feet (3 metre) intervals as per schematics for ease of identification and maintenance. Control wiring shall not be run next to power wiring. A minimum space of 4" (100mm) between both control and power cables shall apply.

2.7 LOW AMBIENT HEATING ENCLOSURES

- .1 General
 - .1 All condensing units shall be placed inside low ambient heating enclosure that ensure the condensing units are not exposed to ambient temperatures below 15F (9.4C)
 - .2 Enclosure shall allow VRV system to deliver consistent heating capacity down to -40F (-40C). System capacity between 15F (9.4C) and -40F(-40C) shall be equal to or above the system's capacity at 15F (9.4C), as scheduled. VRV system shall not suffer any loss in efficiency between 15F (9.4C) and -40F (-40C).
- .2 Unit Construction:
 - .1 Enclosure shall be shipped with condensing units mounted inside, and complete with louvers, motorized dampers, intake and exhaust hoods, 1" (25mm) insulated walls. insulated drain pan with heat trace and integrated controls.
 - .2 Unit casing shall be of minimum 18 gauge satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be electrostatically applied sky grey enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.
 - .3 The unit shall be weatherproofed and equipped for installation outdoors. Enclosure shall be for outdoor installation shipped in modules and field assembled by Contractor. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1" (25mm) galvanized inlet screens; rain gutters or diverters over all access doors/panels. All joints caulked with a water resistant sealant.
 - .4 Provide full perimeter roof mounting curb of heavy gauge sheet metal, minimum of 14" (350mm) high, and complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 1" (25mm) upturn on inner perimeter, to provide a complete seal against the elements. External insulation and flashing of the roof-mounting curb shall be provided by the Roofing Subcontractor. The roof curb to be complete with seismic anchors to suit the requirements of the seismic rating of the building. The curb shall be anchored to the building structure. The curb and unit base frame shall be supplied with structural anchors to fasten the unit to the curb.
- .3 Heat Exchanger:
 - .1 Enclosure shall include factory mounted sealed combustion gas fired unit heaters. Gas piping and termination to unit heaters shall be by others. The gas heater exhaust vent extension and vent cap shall be shipped loose by the unit manufacturer and field install by mechanical contractor.
 - .2 Stainless steel heat exchanger for 100% outdoor air heating
 - .3 Modulating of 2 stages gas fired burner
- .4 Power:
 - .1 Enclosure shall feature a single point power connection with individual internal disconnect switches for each condensing unit, factory mounted. Main disconnect switch for the enclosure shall be supplied and installed by Division 26.
 - .2 Electric: as shown in the schedule.
- .5 Controller:

- .1 Enclosure shall be complete with packaged controller, with touch screen and BACnet capabilities.
- .6 Enclosure shall be CSA approved and labeled.
- .7 Capacity: as shown in the mechanical equipment schedule

2.8 BRANCH SELECTOR BOX

- .1 Branch selector boxes shall be located as shown on the drawing. Selector box cabinets shall have a galvanized steel plate casing and shall house multiple refrigeration control valves, a liquid gas separator and a tube in tube heat exchanger. The unit shall contain sound absorption thermal insulating material made of flame and heat resistant foamed polyethylene.
- .2 The branch selector box shall also contain the required electronics to facilitate communications between the main processor and between the indoor units. The use of EEV's will ensure continuous heating during defrost (with air cooled systems), and have no heating impact during changeover modes.
- .3 Branch selector boxes shall not require drain pan and drain connections. Manufacturers with branch selector boxes requiring drain connections shall bid as an alternate and carry allowances to compensate for the added costs of the drain connections.
- .4 Manufacturers with branch selector box sizes, arrangements, or locations that differ from what is specified shall make the necessary arrangements to ensure their alternative branch selector boxes both fit in the space and result in the system still meeting CSA B52, included the maximum refrigerant charge allowance

3 EXECUTION

3.1 AIR CONDITIONING

- .1 Install indoor unit in accordance with manufacturer's installation instructions. Make all duct and piping connections necessary.
- .2 Install outdoor unit plumb and level on premanufactured roof stand or wall mounted as required, making all necessary piping connections.
- .3 Install refrigerant line kits in accordance with manufacturer's installation instructions.
- .4 Install pan heater kits in accordance with manufacturer's installation instructions.
- .5 Refrigeration Equipment: prepare system for start-up by having manufacturer's field engineer or factory trained representative supervise testing, and charging of machines.
- .6 Testing:
 - .1 Provide sufficient refrigerant, dry nitrogen and refrigeration oil for pressure and operational testing under manufacturer's supervision.
 - .2 Prior to testing ensure that system is complete. Protect relief valves during test procedure. After completion of test, reconnect and make good piping connections and leak test entire system.
- .7 Power wiring under Division 26.
- .8 Control wiring under this Section.

3.2 VRF SYSTEM INSTALLATION

- .1 VRF System Installation: The placing of all air conditioning equipment, installation of all refrigerant pipework and full commissioning shall be performed by a licensed refrigeration mechanic / installer who shall be trained, and authorized to install the VRF equipment. The installation of all internal and external units, refrigerant pipework, inter-connecting wiring, commissioning and testing shall be carried only by an approved refrigeration systems installers. All the required permits, system registration, and witnessed tests by TSSA shall be the responsibility of this installer. Full access shall be afforded to site during the installations stage of the project to allow them to verify that installation methods are fully in accordance with manufacturer requirements and also TSSA (the enforcing authority) so that the equipment warranties will not be invalidated.
- .2 Refrigerant Pipework:
 - .1 Supply, install, test, and commission all interconnecting refrigeration pipework between the

- outdoor and indoor units.
- .2 All pipework to be carried out in refrigerant quality ACR copper tubing and complete with the appropriate headers and joints. All pipework must be suitable for R410A. Longest possible lengths of copper pipe should be utilized to minimize joints on site.
 - .3 Appropriate refrigeration installation tools must be utilised. Dry Nitrogen must be utilized at all times in the system during brazing.
 - .4 All pipework (suction and liquid lines) to be insulated with slip on close cell elastomeric pipe insulation (as manufactured by Armaflex or equal and approved) having a wall thickness of not less than ½".
 - .5 After installation of pipework, and prior to sealing of insulation joints and starting of equipment, pipework should be pressure tested. 44 PSIG test for 3 minutes minimum, then 217 PSIG for 3 minutes minimum, then 478 PSIG for 3 minutes minimum, then strength test to 600PSIG.
 - .6 Check the system for leaks and deformation, then lower the pressure back to 478 PSIG and pressure test for 24 hours and check for leaks. The system should then be vacuumed/dehydrated to 300 microns, and hold at that vacuum for 12 hours (minimum).
 - .7 Refrigerant (R410A) charge (by weight) must be calculated based on the actual installed length of pipe work in accordance with Mitsubishi recommendations. See local manufacturer representative for assistance with refrigerant charge calculations. The charging should be carried out with an appropriate charging station.
 - .8 Pipework to be properly fixed and supported at a minimum of 1.5 metres (5 feet) centres or as specified by local code, and where required should be run on galvanized uni-strut trays. All pipework to be labelled with ID number (condensing unit ref.) at 10 feet (3 metre) intervals.
 - .9 Joints in copper pipe shall be brazed. Brazing shall be carried out to the requirements of the local codes and as per the Canadian copper and brass development association recommendations.
- .3 Condensate Pipework: A condensate line shall be installed to each fan coil unit. This shall be installed and insulated all as per the standard specification. Minimum size of condensate pipes to be 1" (25mm) copper insulated and pumped or by gravity from each fan coil/cassette, drains to run 1:80 min falls as indicated on drawings.
- .4 All pipework (suction and liquid lines) to be insulated with slip on close cell elastomeric pipe insulation (as manufactured by Armaflex or equal and approved) having a wall thickness of not less than ½" (13mm).
- .5 A condensate line shall be installed to each fan coil unit. This shall be installed and insulated all as per the standard specification. Minimum size of condensate pipes to be 1" (25mm) copper insulated and pumped from each fan coil/cassette to drains as shown in the drawings.
- .6 Log Books: Full commissioning Logs shall be supplied by the local manufacturer distributor. These shall be completed fully and included with the main Installation and Operation Manuals prior to hand over. In addition, commissioning logs shall be returned to manufacturer.

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 Common Work Results specifies items common to all Sections of Mechanical Divisions 20, 21, 22, 23 and applies to and governs all work of Mechanical Division 20, 21, 22 and 23.

1.3 SECTION INCLUDES

- .1 Unit heaters.
- .2 Cabinet unit heaters.
- .3 Ceiling Radiant Panel Radiators.
- .4 Convectors.
- .5 Wall Fin.
- .6 Electric Duct Heater.

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 Owner's 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 Engineered Air Model H
 - .2 Sterling
 - .3 Sigma
 - .4 Trane
 - .5 Rittling
 - .6 Rosemax

- .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 louvers 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 Engineered Air Model CUH.
 - .2 Sterling
 - .3 Sigma
 - .4 Trane
 - .5 Rittling
 - .6 Rosemax
- .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:
 - .1 Factory baked enamel finish, standard colour as selected by 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: Washable Aluminum mesh filters are standard. MERV 8 rated 1" (25 mm) thick glass fibre throw-away optional.
- .9 Mixing Dampers: Where indicated, mixing sections with dampers. Refer to Section 25 for operating sequence.
- .10 Size and Capacity: As Scheduled.

2.3 CEILING RADIANT PANEL RADIATORS

- .1 Manufacturers:
 - .1 Frenger/TWA
 - .2 Airtex
 - .3 Sigma
 - .4 Airtite
 - .5 Rittling
 - .6 Rosemex
- .2 Ceiling panels: Constructed of modular 5" (125 mm) wide aluminum extrusions with interlocking edges, manufactured and assembled to sizes and configurations indicated.
- .3 Pipe Coil: 5" (125 mm) module to incorporate extruded void into which continuous 5/8" (16mm) copper pipe is rolled and thermally bonded. Provide return bends for two water connections to each panel.
- .4 Where indicated provide panels which incorporate extruded drapery track.
- .5 Cross brace entire assembly with structural members and insulate with 2" (50mm) R-6.8 thick foil back fibreglass batt insulation.
- .6 Configure panel heaters to run wall to wall.

- .7 Ceiling panels mounted in drywall (GWB) ceilings shall include 1" (25mm) extruded aluminum T section frame with welded corners and integral access panel.
- .8 Size and capacity: As scheduled.

2.4 WALL FIN

- .1 Manufacturers:
 - .1 Engineered Air
 - .2 Kampmann
 - .3 Jaga
 - .4 Sterling
 - .5 Sigma
 - .6 Trane
- .2 Wall fin shall be flat top wall cabinet convector, Fabricated from 16 gauge reinforced sheet steel with removable front panel, top outlet grille and all necessary mounting hardware.
- .3 Finish painted in colour selected from standard colour chart. Colour to be selected during shop drawings review stage.
- .4 Heating Elements shall be aluminum fins mechanically bonded to seamless copper tubing.

2.5 CONVECTORS

- .1 Manufacturers:
 - .1 Engineered Air C Series
 - .2 Sterling SW-A
 - .3 Sigma CWS
 - .4 Trane
 - .5 Rittling
 - .6 Rosemex
- .2 Convectors shall be sloping wall cabinet convectors, fabricated from 14 gauge (1.7mm) reinforced sheet steel with removable front panel, top outlet grille and all necessary mounting hardware.
- .3 Finish:
 - .1 Factory baked enamel finish, standard colour as selected by Architect.
- .4 Heating elements shall be aluminum fins mechanically bonded to seamless copper tubing.
- .5 Size and capacities: As scheduled.

2.6 HOT-WATER BASEBOARD RADIATORS WALL FIN

- .1 Manufacturers:
 - .1 Engineered Air WS
 - .2 Sterling Classic
 - .3 Sigma SWE-S
 - .4 Trane
 - .5 Rosemex
 - .6 Rittling
- .2 Performance Ratings: Rate baseboard radiators according to Hydronics Institute's "I=B=R Testing and Rating Standard for Baseboard Radiation."
- .3 Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on polypropylene element glides. One end of tube shall be belled.
 - .1 Tube Diameter: 1"x1-1/4" (25 mm and 32 mm)
 - .2 Fin Size: 83 mm x 83 mm and 83 mm x 133 mm
 - .3 Fin Spacing: 131/m, 164/m, 190/m
 - .4 Number of Tiers: 1 or 2 as indicated
 - .5 Minimum Water Velocity: 9.1 m/min
- .4 Enclosures: Minimum 0.84 mm thick steel.
 - .1 End panel
 - .2 End caps
 - .3 Inside and outside corners
 - .4 Joiner pieces to snap together

- .5 Finish:
 - .1 Factory baked enamel finish, standard colour as selected by Architect.
- .6 Element Brackets: Primed and painted steel to support front panel and element.
- .7 Size and capacities: As scheduled.

2.7 ELECTRIC DUCT HEATERS

- .1 Manufacturers:
 - .1 Chromalox.
 - .2 Indeeco.
 - .3 Markel Products Co.
 - .4 Nailor Industries, Inc.
 - .5 Trane Inc
 - .6 Thermolec
 - .7 Neptronic
- .2 General
 - .1 All materials shall meet or exceed all applicable referenced standards, provincial and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
Electric duct heaters of types, sizes, ratings, and characteristics as indicated on mechanical equipment schedule drawings.
- .3 Heating Elements:
 - .1 Open Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame.
 - .2 Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
 - .3 Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.
 - .4 Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
- .4 Coil Layout: Heaters shall be CSA (NRTL/C) approved for horizontal ducts air flow.
- .5 Casing Assembly: Slip-in type, galvanized-steel frame.
- .6 Over-Temperature Protection:
 - .1 Serviceable through terminal unit without removing heater from duct or unit.
 - .2 Disk-type, automatic reset, thermal-cutout safety devices for primary over-temperature protection.
 - .3 Load carrying, manual reset or manually replaceable thermal cutouts, factory wired in series with each heater stage for secondary protection.
 - .4 Airflow switch, diaphragm operated differential pressure switch to prevent duct heater from operating when there is no air flow. Cut-outs shall de-energize the heater in case of insufficient air flow
- .7 Control Panel: Mounted on unit, with means of a safety disconnect and overcurrent protection. Include the following controls:
 - .1 Magnetic contactor.
 - .2 Modulating control mode with Silicon-Controlled Rectifier (SCR)
 - .3 Time-delay relay.
 - .4 Pilot lights; one per step, "power on", and "low air flow".
 - .5 24 volts step down transformer.
 - .6 Electronic duct air discharge thermostat sensor (DTS)
 - .7 Provide single point power connection: 240V/1ph/60hz; load as shown on mechanical equipment schedule.
- .8 For maintenance and safety purposes, a built-in disconnect shall be supplied to switch the power off at the heater location.
- .9 Load fuses shall be supplied as required by NEC (National Electrical Code).
- .10 Permanently attach a separate, complete, and specific wiring diagram to each heater. Typical wiring diagrams are not acceptable. Clearly mark power and control terminals in terminal unit identical to the wiring diagram.
- .11 Size and capacities: 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 with shut-off valve on supply and lock shield 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.
- .7 Provide ceiling radiant panel heaters where and as indicated and in accordance with manufacturer's installation instructions and as follows.
 - .1 Refer to architectural reflected ceiling plans and room finish schedule in addition to mechanical drawings to determine location, quantity, and finish of radiant panels.
 - .2 Co-operate with other trades working in the ceiling to achieve a neat, well-coordinated overall installation.
 - .3 Make all piping connections. Hot water heating supply shall connect first to panel tubing pass closet to perimeter wall. Multiple panels shall be circuited to ensure serpentine flow over complete length of zone. Individual serpentine panel coil unacceptable for multiple panel zones.
 - .4 Panels shall run continuous from wall to wall and shall be field trimmed to length ensuring adequate expansion allowance while maintaining panel end coverage by architectural mouldings.
 - .5 Ceiling support mouldings for Radiant Panels to be supplied and installed by Division 9. Ensure ceiling openings and wall mouldings are installed as per radiant panel shop drawings.
 - .6 All radiant panels shall be installed by personnel wearing clean white gloves to avoid soiling of panel face. Hanger wires for safety and seismic restraint shall be installed at 48" (1200 mm) on centre or as recommended by the manufacturer.
 - .7 All system piping shall be thoroughly cleaned, flushed, drained, and refilled before radiant panels are connected into the system.
 - .8 Each group or zone of coils shall be given a pressure test in accordance with Division 23.
 - .9 No installation of finished radiant panels shall begin until all glazing has been completed and all exterior openings closed in
 - .10 All active panels shall be covered with a minimum of 2" (50 mm) thick foil back batt insulation.
 - .11 Valves for framed linear panels to be located over access sections to allow servicing through access panel.
- .8 Electric Duct Heater
 - .1 Installation shall meet or exceed all applicable provincial and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
 - .2 All installation shall be in accordance with manufacturer's published recommendations.
 - .3 Inspect areas and conditions under which terminal units are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to installer.
 - .4 Do not operate electric heaters for any purpose until ductwork is clean of any possible debris.
 - .5 Maintain minimum working clearances around the heater electrical panel in accordance with NEC Article 110.
 - .6 Install duct heaters in metal ducts and casings constructed according to SMACNA "HVAC Duct Construction Standards."
 - .7 If applicable, anchor duct heaters in position using suitable supports.
 - .8 Connect duct heaters and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment

connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

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 für 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 Owner's 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 Mortar-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 Rehau (Klimatrol Environmental Systems Ltd.)
 - .2 AquaHeat
 - .3 WattsRadiant, Inc.
 - .4 Uponor Wirsbo
 - .5 Heat Link

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 Manifolds: 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/manufacture'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 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 “reviewed”, “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 “reviewed 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 In the case of discrepancies or conflicts between the drawings and specification, the documents will govern in the following order:
 - .1 The specification
 - .2 Drawings of larger scale
 - .3 Drawings of smaller scale
 - .4 Drawings of later date when the scale of the drawings is the same
- .9 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.
- .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 review and acceptance.
- .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 acceptable 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 review and acceptance 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 Do not supply products of different types that have been "bulked" by a supplier who has quoted a lump sum price for the "bulked" products.
- .5 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 one (1) hour 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 reviewed and accepted 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 PERMITS, FEES, AND CERTIFICATES

- .1 Apply for, obtain and pay for all permits required to complete the electrical work.
- .2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.
- .3 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

1.16 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.

1.17 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. The number of copies of shop drawings and/or product data sheets will be as later directed.
- .2 Wherever possible, shop drawings and/or product data sheets are to be 216 mm x 280 mm (8½" x 11"), 216 mm x 356 mm (8½" x 14"), or 356 mm x 432 mm (11" x 17") single side white bond paper with sufficient clear space for review stamps and comments.
- .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, as per the Electrical Supplementary Bid Form as applicable, 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 the Consultant's review is final and no re-submittal is required subject to compliance with any modifications indicated.
 - .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 Consultant will retain one or two copies of each shop drawing or product data sheet submission.
 - .8 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. The Contractor remains responsible for dimensions to be confirmed and correlated at the job site, for the information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."
 - .9 Submit preliminary short circuit study with distribution equipment shop drawings in sufficient detail to include and provide ratings for all components and wiring and be in conformance with Section 26 03 15.
 - .10 Provide final commissioning report with record drawings.
 - .11 Provide draft copy of all manuals 100 days prior to expected date of completion of work for review by Owner.
 - .12 Prepare copies of all schematics for training purposes and submit to Owner for review 30 days prior to demonstration and training purposes.

1.18 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 review and acceptance, a quotation being your proposed cost for executing the change or revision.
- .2 The Contractor's quotation shall 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 listed in the Supplementary Bid Form 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, the Supplementary Conditions 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.

1.19 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.
- .4 When the Consultant is requested to perform a field review and the work is not ready to be reviewed, reimburse the Consultant for all time and travel expenses.

1.20 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 review and acceptance of the Consultant.

1.21 TRIAL USAGE

- .1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with the Specification and governing Codes and Regulations, prior to Substantial Performance of the work.
- .2 When, in the opinion of the Consultant, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.
- .3 All tests are not to be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the equipment or system due to the test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.
- .4 When, in the Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from the site and replace them with acceptable equipment and/or products, at no additional cost.

1.22 PROJECT CLOSEOUT SUBMITTALS

- .1 Prior to application for Substantial Performance of the Project, submit all required documentation specified, including the following:
 - .1 Operating and Maintenance Manuals
 - .2 as-built record drawings and associated data

- .3 extended warranties for equipment as specified
- .4 identified keys for mechanical equipment and/or panels for which keys are required
- .5 other data or products specified

1.23 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 an Introduction sheet listing the Consultant's, Contractor's, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses. Include special telephone numbers for service departments on normal and emergency call basis.
 - .2 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.
 - .3 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
 - .4 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
 - .5 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-through 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.

1.24 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.

1.25 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 recommending acceptance of monthly progress payment claims.
- .2 The payment breakdown is subject to the Consultant's review and acceptance. Progress payments will not be processed until a reviewed and accepted breakdown is in place. The breakdown shall 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.

1.26 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 is to protect his Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss of damage resulting from the professional services rendered by his Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.
- .3 Liability insurance requirements are as follows:
 - .1 coverage is to be a minimum of \$1,000,000.00 inclusive of any one occurrence, or as indicated in the Division 0.
 - .2 the insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice
 - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work
 - .4 evidence of the required liability insurance in such forms as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services

1.27 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.

1.28 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.

1.29 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.

1.30 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.

1.31 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.

1.32 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.

1.33 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.

1.34 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.

1.35 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.

1.36 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.
EDIT NOTE: Ref: paragraph .3. Use only if a Commissioning Agent is required and commissioning is specified in section 16095 – 26 03 20.
- .2 Commissioning and the use of an independent Commissioning Agent is specified in the electrical work Section entitled Electrical Work Commissioning. Carefully read the Electrical Work Commissioning Section and include for all specified requirements.

1.37 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.

1.38 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 WATERPROOFING SEAL MATERIALS

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit, duct, etc., and the sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the conduit, duct, etc., size and the sleeve size or wall opening size. Acceptable products are:
 - .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S
 - .2 The Metraflex Co. "MetraSeal" type ES

2.4 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.

2.5 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.

2.6 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 (1/2" x 2") for smaller items such as single phase starters and disconnect switches, minimum 25 mm x 65 mm (1" x 2 1/2") 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 accepted 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 shall be submitted to the Consultant for review and acceptance 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.

2.7 WALL MOUNTING EQUIPMENT BACKBOARDS

- .1 Construction grade fir plywood, G1S, 20 mm ($\frac{3}{4}$ ") 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.

2.8 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.

2.9 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 sprinklered areas – type 2
 - .2 Indoor in high humidity/washdown areas – type 4 water-tight
 - .3 Indoor in corrosive environments – type 4X 304 stainless steel
 - .4 Indoor explosion-proof (Class 1, Groups C & D) – type 7
 - .5 Outdoor – type 3R rain-proof
 - .6 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 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around the conduit, duct, or cable.
- .5 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 based 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
- .6 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.
- .7 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.
- .8 "Gang" type sleeving will not be permitted.
- .9 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 accepted 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.

3.11 ELECTRICAL WORK IDENTIFICATION

- .1 General: The following requirements apply to electrical work identification:
 - .1 The size and wording of identification nameplates must be accepted 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 transformer vaults
 - .2 On all doors into high voltage switchgear rooms
 - .3 On collector bus enclosure
 - .4 On pad mounted transformer enclosures
- .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
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	red
Up to 28 kV	Yellow	Black
Telephone	Green	
Other communication systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Security Systems	Red	Yellow
Isolated Power	Orange	

- .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.

3.12 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.

3.13 FINISH PAINTING OF ELECTRICAL WORK

- .1 Finish paint exposed electrical work as specified and/or scheduled in accordance with requirements of the painting Section in Division 09.

3.14 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

3.15 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.

3.16 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:
 - .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 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.

3.17 INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS

- .1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight until 6:00 a.m.
- .2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform the Owner and Consultant in writing 5 working days in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.
- .5 Coordinate with the Owner all start-up of existing electrical systems which have been shut-down.
- .6 Include in Bid Price for all overtime or premium time hours necessary to minimize duration of service interruptions.

3.18 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 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.

3.19 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 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.

3.20 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.

3.21 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.

3.22 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.

3.23 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 based 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

3.24 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 were 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.

3.25 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.

3.26 USE OF ELECTRICAL SYSTEMS FOR TEMPORARY POWER AND LIGHTING

- .1 Permanent building electrical systems are not to be used for temporary power and lighting purposes during construction.
- .2 Each entire system is complete, tested, and commissioned
- .3 Building has been closed in and areas are clean and will not thereafter be subjected to dust-producing processes
- .4 There is no possibility of damage from any cause
- .5 All systems are operated as per the manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis
- .6 Warranties are not affected in any way
- .7 Regular preventive and all other manufacturer's recommended maintenance routines are performed.
- .8 before Substantial Performance, each entire system is to be refurbished, cleaned internally and externally, and restored to "as-new" condition, and lighting fixture lamps are replaced
- .9 energy costs are to be paid by the Contractor.]

3.27 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

- .1 Maintain all equipment in accordance with the manufacturer's printed instructions prior testing and commissioning.

3.28 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.

3.29 EQUIPMENT AND SYSTEM COMMISSIONING

- .1 Commissioning shall conform to the following standards:
- .2 CAN/CSA Z318.0-05 (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.

3.30 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.

3.31 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 1.25
.2 Importance factor for earthquake loads and effects, IE, is 1.5.
.2 Site classification for seismic site response is E (VERIFY WITH SOILS REPORT)
.3 Climatic and Seismic Data from the Ontario Building Code for specific location:

<u>Location</u>	<u>Sa(0.2)</u>	<u>Sa(1.0)</u>	<u>q (1/50)</u>
London	0.15	0.055	0.47

- .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 (3.2mm)
- .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.
- .1

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 HIGH VOLTAGE CABLE TESTING

- .1 Testing requirements for high voltage cable and are specified with the cables.

3.3 MAIN POWER TRANSFORMER TESTS

- .1 Test main power transformers prior to energizing and placing in regular service. Tests are to include a voltage ratio test, phase angle test, insulation resistance test, oil sampling test for liquid filled transformers, and any other transformer manufacturer's recommended tests.

3.4 EMERGENCY POWER SYSTEM

- .1 Perform testing and coordination of the emergency engine generator set and distribution to ensure that the system performs in accordance with requirements of CSA C282, Emergency Electrical Power Supply for Buildings, and, where applicable, CAN/CSA Z32. Electrical Safety and Essential Electrical Systems in Health Care Facilities. Ensure that the engine-generator set manufacturer and the testing and coordination study company cooperate to conform to the CSA requirements. Perform the necessary adjustments, when required, such that the system transfers essential loads to emergency power within the required response time.

3.5 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.

3.6 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 G. T. Wood Co. Ltd.
 - .2 Brosz and Associates Ltd.
 - .3 Rondar Inc.
 - .4 Siemens Westinghouse Technical Services
 - .5 Schneider Canada
 - .6 Cutler-Hammer Engineering Services
- .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 arcing 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 Where existing distribution equipment exists and is to remain, review the existing distribution equipment and, where possible, obtain the existing distribution system coordination study to determine the best coordination between the existing and new equipment. If an existing coordination study is not available, survey the existing equipment and prepare calculations for proper coordination between the new and existing equipment. Where defective or incorrectly applied relays or breakers are found, clearly identify the problem on curves submitted with the report and suggest a recommended course of action.
- .11 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 Necessary data required to complete this coordination study shall be obtained from the Supply Authority and manufacturers of protective devices in the system.
- .13 Ensure that the suggested settings of the devices, as determined from the coordination study are acceptable to the Supply Authority.
- .14 Short circuit and coordination study shall be prepared under the supervision and sealed by a Professional engineer licensed in the Province of Ontario.
- .15 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.

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 Include in Base Bid price, the amount of indicated in Section 16010 3.29 Allowances as a Cash Allowance for payment of Supply Authority charges with respect to this project. Cash Allowance are governed by Section 01020.
- .3 Advise Supply Authority when construction begins and when work is being done.

1.4 SUBMITTALS

- .1 Shop drawings in accordance with 16010 for the following:
 - .1
- .2 Contractor's Material and Test Certificate as per Section 16010.
- .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 in accordance with Section 16106, Installation of Cables in Trenches and in Ducts and Section 16111 - Raceways.
- .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 with Section 16450, Grounding -Secondary.
- .6 See Section 16105, 16106, 16107 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 Coordinate the duct installation with the excavation and backfill work specified in the Excavation and Backfill Section and clearly mark the route of the ductbank and advise the depth and slope.
- .4 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.
- .5 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.
- .6 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.

- .7 Provide bell fittings at duct terminations at manholes and buildings.
- .8 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.
- .9 Provide a continuous pull rope in each duct, with 3 m (10') of excess rope at each end.
- .10 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.

3.2 CONCRETE ENCASEMENT

- .1 After completion of the duct installation and successful duct clearance testing, encase each duct in a minimum 75 mm (3") envelope of concrete. Conform to the following requirements:
 - .1 Concrete is to be minimum 20 mPa ready mix concrete with maximum 10 mm (¾") aggregate in accordance with requirements of the Cast-In-Place Concrete Section
 - .2 Provide anchors, ties and trench jacks as required to secure the ducts in place and prevent movement during the concrete pour
 - .3 Fill the entire space between ducts with concrete, and be present during the pour to ensure that the ducts are not displaced or damaged
 - .4 Provide four 3 m (10') lengths of 15M reinforcing rods, one in each corner of the concrete encasement and wired to 10M dowels supported to duct spacers, when connecting duct to manholes or buildings, and where the ductbank crosses roads and driveways
 - .5 Allow concrete to attain 50% of its specified strength prior to backfilling

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, 90° C (194° 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, 90°C (194° F) rated, X-link polyethylene insulated for #8 AWG and larger.
 - .3 "TWU" single copper conductor in accordance with CSA C22.2 No. 75, 60° C (140° F) rated, PVC insulated
 - .4 "AC90" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (194° F) rated, X-linked polyethylene insulated copper conductors, a concentric ground conductor, and an interlocking aluminum armor jacket
 - .5 "AC90 ISO-BX" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (194° F) rated, X-linked polyethylene insulated copper conductors, a concentric bare ground conductor, an insulated copper ground conductor, and an interlocking aluminum armour jacket
 - .6 Equal to Tyco/Pyrotenax "MI" ULC two hour fire rated copper conductor in accordance with CSA C22.2 No. 124, Mineral-Insulated Cable, 90° C (194° F) rated, consisting of a solid conductor, magnesium oxide insulation, a seamless soft drawn copper sheath, and factory supplied Pyrotenax terminations
 - .7 Equal to Tyco/Raychem "CI" cable in accordance with requirements of CSA C22.2 No. 208, Fire Alarm and Signal Cable, FAS90 shielded or un-shielded as required, 90°C (194°F) rated, consisting of a copper conductor, silicone rubber insulation, and a polyolefin outer jacket
 - .8 Two hour fire rated cables equal to Lifeline 2 hour rated RHW-2, RW90 and C1. Cable systems to be CSA and ULC certified 2 hour fire rating.

2.2 LOW VOLTAGE (24 VOLT) CONDUCTORS

- .1 "T-90" or "RW90" stranded copper conductors as specified above
- .2 Equal to Nexans Canada "Securex II" FAS/LVT/FT1300 volt wire to CSA C22.2 No. 208, Fire Alarm and Signal Wire, 105° C (220° F) rated, consisting of solid copper conductors (stranded for control wiring), flame retardant PVC insulation, an aluminum/Mylar optional shield with a #22 AWG tinned copper drain wire, if required for the application, an outer PVC jacket, and, if required for the application, interlocking aluminum armour with or without an overall jacket.

2.3 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.
- .4 Mineral Insulated Conductors: Tyco/Pyrotenax "Pyropak" connectors, complete with brass plates with drilled and tapped mounting holes for connections to ferrous cabinets.
- .5 Corflex/Teck Cable: Connector and termination hardware supplied by the cable manufacturer to suit the application.

2.4 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 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
 - .3 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 Do not splice mineral insulated "MI" cable

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 Fire Rated Conductors: Unless otherwise specified herein or on the drawings, fire rated conductors are to be ULC two hour rated bare "MI" cable, or "RHW" or "CI" conductors. The 2 hour rated type "RHW" and "CI" conductors to be installed in steel conduit as per manufacturers recommendations.
 - .1 conductors from engine-generator set to transfer switch
 - .2 power feeders to fire alarm panels, transponders and annunciators
 - .3 fire alarm system risers and other feeders as shown or specified
 - .4 any other conductors as specified on the drawings
- .4 "MI" Mineral Insulated Conductor Installation Requirements: Install type "MI" mineral insulated conductors in accordance with the manufacturer's instructions and recommendations, including the following:
 - .1 provide proper clips, wall brackets, and other support hardware either shown or required

- .2 terminate the cable using connectors and installation tools supplied by the cable manufacturer
- .3 terminate cable immediately after installation to avoid moisture ingress
- .4 do not splice "MI" cables
- .5 after installation and termination, test cable, including a megger test, in the presence of the manufacturer's authorized representative
- .6 obtain from the manufacturer a letter stating that the "MI" cable has been properly installed, tested, and is ready to be energized, and submit the letter and test result sheets to the Consultant
- .5 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.
- .6 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
- .7 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 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.
- .2 Conform to CSA-C22.2-31.
- .3 Coordinate equipment physical size and space limitations

1.3 SUBMITTALS

- .1 Shop drawings and product data in accordance with Section 26 03 00.
- .2 Indicate on shop drawings:
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
- .3 Include time-current characteristic curves for breakers and fuses rated above 200 A.
- .4 Contractor's Material and Test Certificate as per Section 26 03 00.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for service entrance board for incorporation into manuals specified in Section 26 03 00, Electrical Work General Requirements.
- .2 Submit 3 copies maintenance data for complete assembly including components.

1.5 MAINTENANCE MATERIAL

- .1 Include:
 - .1 3 fuses for each type above 600 A.
 - .2 6 fuses for each type up to and including 600 A.

1.6 SOURCE QUALITY CONTROL

- .1 Consultant may wish to witness final factory tests.
- .2 Notify Consultant in writing 10 days in advance that service entrance board is ready for testing.
- .3 Submit copies of certified test results.

1.7 MANUFACTURERS

- .1 Acceptable manufacturers: Siemens, Square D, Eaton.

1.8 SUBMITTALS

- .1 Shop drawings and product data in accordance with Section 26 03 00, Electrical Work General Requirements.
- .2 Contractor's Material and Test Certificate as per Section 26 03 00, Electrical Work General Requirements.
- .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 withstands curves data.

- .4 Main service branch breakers/fuses time-current characteristics and coordination thereof with service box fuse or breaker.

2 PRODUCTS

2.1 SERVICE ENTRANCE BOARD

- .1 Rating amps as per drawings, short circuit current 42kA (rms symmetrical). Breakers minimum interrupting rating not less than service entrance board short circuit rating.
- .2 Where fuses with maximum let-through current are indicated, provide a lamacoid label on front cover of equipment as per paragraph 26 03 00.
- .3 Cubicles: wall-mounted, dead front, size as indicated.
- .4 Barrier metering section from adjoining sections.
- .5 Provision for installation of Supply Authority metering.
- .6 Owner's metering.
- .7 Distribution section.
- .8 Hinged access panels with captive knurled thumb screws.
- .9 Bus bars and main connections; 99.3% copper.
- .10 Bus from load terminals of main breaker to main lugs of distribution section.
- .11 Cable from load terminals of main disconnect switch to metering cabinet section and cable from metering to lugs of distribution section.
- .12 Identify phases with colour coding.
- .13 Meters in accordance with Supply Authority Requirements and Owner's DMS.
- .14 Note maximum physical dimension limitations must suit layout shown on contract drawings.

2.2 MOULDED CASE CIRCUIT BREAKERS

2.3 FUSIBLE DISCONNECTS AND FUSES

2.4 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for grounding cable size as indicated.

2.5 GROUND FAULT UNIT

2.6 SUPPLY AUTHORITY METERING

- .1 Mounting accessories and wiring for following, supplied by Supply Authority:
 - .1 Potential transformers.
 - .2 Current transformers.
 - .3 Watthour meter.
 - .4 Demand meter with kWH register.
- .2 Separate cabinet and metal raceway for exclusive use of Supply Authority metering. See 16428 re Owner's DMS.

2.7 FINISHES

- .1 Apply finishes in accordance with Section 26 03 00, Electrical Work General Requirements.
 - .1 Service entrance board exterior grey.
 - .2 Supply 2 spray cans touch-up enamel.

2.8 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 03 00, Electrical Work General Requirements.
- .2 Nameplates:
 - .1 White plate, black letters, size 7.

- .2 Complete board labelled: "Amperage 600 V."
- .3 Main disconnect labelled: "Main Switch."
- .4 All Branch breakers labelled: "Feeder No 1, "Feeder No 2", "Feeder No 3", as indicated.

3 EXECUTION

3.1 INSTALLATION

- .1 Locate service entrance board and fasten to wall.
- .2 Connect main secondary service to line terminals of main disconnect switch.
- .3 Connect load terminals of distribution breaker's to feeders.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run grounding conductor OESC - table 17 AWG green insulated copper in 1" (25 mm) conduit from ground bus to building ground.
- .6 Check trip unit settings and fuse sizes against co-ordination study to ensure proper working and protection of components.

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.

2 PRODUCTS

2.1 POWER SUPPLY AUTHORITY METER CABINET

- .1 CSA certified minimum 1219 mm x 1219 mm x 300 mm deep (4' x 4' 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 (1/2") 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 2 sprinkler-proof enclosure rating

2.2 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.

2.3 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 90° 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 sheets for all equipment specified in this Section. Both shop drawings and product data sheets must indicate that the equipment to be supplied meets all requirements of this Section of the Specification.
- .2 Test Reports: Submit signed test reports for all testing work specified in Part 3 of the Section.
- .3 Manufacturer's Installation Certification Letter: Submit an installation certification letter from the substation manufacturer as specified in Part 3 of this Section.

1.2 QUALITY ASSURANCE

- .1 Codes and Standards: Each ground fault unit is to be in accordance with requirements of the following Codes and Standards:
 - .1 CAN/CSA C22.2 No. 144, Ground Fault Circuit Interrupters.
 - .2 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment
- .2 Training and Instructions: As specified in Part 3 of this Section.

2 PRODUCTS

2.1 GROUND FAULT PROTECTION EQUIPMENT

- .1 Panel mounting (unless otherwise indicated) ground fault protection unit(s) supplied by one manufacturer, designed to operate instantaneously at the ground current setting, and with characteristics as indicated on the drawings. Each unit is to be complete with:
 - .1 A ground fault sensing relay for operation at the setting indicated on the drawings, and with 120 volt control voltage
 - .2 An ammeter with a 0 to 5 A scale to indicate the ground fault current
 - .3 A three position sensitivity control switch to select the value of leakage current at which the relay will operate
 - .4 A manual reset switch with manual target indication and SPDT contacts for alarm and trip, and A rest button for the contacts and target
 - .5 A zero sequence transformer of a type to suit the conductors involved, with 300 to 3000 mA range
 - .6 An artificial neutral and grounding resistor or a neutral ground resistor unit to suit the system
- .2 Acceptable Manufacturers: Acceptable manufacturers are:
 - .1 Schneider Electric Canada
 - .2 Eaton Electric Canada (Cutler-Hammer)
 - .3 Siemens Canada

3 EXECUTION

3.1 INSTALLATION OF GROUND FAULT PROTECTION EQUIPMENT

- .1 Provide ground fault protection equipment for electric service entrance and distribution equipment where shown.
- .2 Where ground fault equipment is to be part of an assembly such as switchgear, arrange for the ground fault equipment to be shipped to the distribution equipment manufacturer's plant for factory installation.
- .3 Ensure that the neutral on the load side of the sensor is not grounded, and that phase conductors including the neutral are installed through the zero sequence transformer.
- .4 Make all required conductor connections with proper terminations in accordance with the ground fault unit manufacturer's instructions and requirements.

- .5 When installation is complete but before the system is energized, arrange for the manufacturer's authorized service representative to visit the site to inspect the installation, check trip settings, test operation of the units including simulated ground faults, and when the inspections and tests have been satisfactorily completed, to certify in writing that each unit has been properly installed, connected, checked and operated as intended. Submit a copy of the letter to the Consultant.

3.2 TRAINING AND INSTRUCTION

- .1 Ground fault protection equipment operation and maintenance training is to be done by qualified manufacture's personnel in accordance with requirements specified in the electrical work Section entitled Electrical Work General Requirements, and is to consist of a minimum of two on-site sessions for six people per session.

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. 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 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 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 For free-standing floor mounted panelboards, reinforcement as required for a rigid enclosure
 - .5 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 40° C (105° 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 40°C (105°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
- .5 Switch and Fuse Panelboards: Fusible switches are to be quick-make, quick-break, visible contact bolt-on switches in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures, sized in accordance with the drawing schedules, and complete with:
 - .1 A top main switch, as indicated.
 - .2 Operating handles which protrude through the dead front enclosure, interlocked with the switch mechanism, and equipped with facilities for padlocking in either the "ON" or "OFF" position
 - .3 Fuse clips, and HRC fuses as per the drawing schedule
- .6 Modifications & Accessories: Panelboards are to be factory equipped with modifications and accessories as follows:
 - .1 Non-ferrous entry plates for MI cables, where MI cables enter or exit panelboards
 - .2 A barriered main breaker or switch, as indicated
- .7 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 Secure each free-standing panelboard, level and plumb, to a concrete housekeeping pad.
- .4 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.
- .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.
- .6 Provide 25% spare breakers in each panel based on number of circuits in use.
- .7 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 steel rods, 20 mm ($\frac{3}{4}$ ") dia., 3 m (10') long, complete with a driving cap and a bronze tip.

2.2 PLATE ELECTRODES

- .1 Copper plates, 2 m² (21.5 ft.²), 2 mm ($\frac{3}{32}$ ") thick.

2.3 GRADIENT CONTROL MAT

- .1 Copper mat, 1.5 m x 1.5 m (5' x 5') consisting of 50 x 50 mesh, 2 mm ($\frac{3}{32}$ ") thick.

2.4 GROUND ROD GROUND CONNECTION INSPECTION BOXES

- .1 PVC or heavy gauge hot dipped galvanized steel or PVC, minimum 200 mm (8") dia., complete with vandal-proof removable cover.

2.5 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.

2.6 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.
- .7 Provide a grounding resistor bank, as indicated.
- .8 Provide zig-zag grounding transformer, as indicated.

3.2 ELECTRODE INSTALLATION

- .1 Provide ground rod or plate electrodes as indicated, and make connections to substation equipment. Ground fences to the grounding system, independent of the station ground.
- .2 Provide gradient control mats where indicated and connect to station ground electrodes and switch mechanism operating rods.

3.3 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.

3.4 NEUTRAL GROUNDING

- .1 Connect transformer neutral and distribution neutral together using 1000 volt insulated conductor to one side of ground test link, the other side of the test link being connected directly to the main station ground. Ensure that distribution neutral and neutrals of potential transformers and service banks are bonded directly to the transformer neutral and not to the main station ground.
- .2 Interconnect electrodes and neutrals at each grounding installation.
- .3 Connect the neutral of the station transformer to main neutral bus with a tap of the same size as the secondary neutral.
- .4 Ground the transformer tank with a continuous conductor from the tank ground lug through the connector on the ground bus to the primary neutral. Connect neutral bushing at the transformer to the primary neutral in the same manner.

3.5 POLE MOUNTED SWITCHING DEVICE GROUNDING

- .1 Provide four ground at the base of each pole on which a group-operated line switching device is mounted. Install the rods in a square formation such that a person operating the switch must stand within the ground rod formation.
- .2 Interconnect ground rods with #2/0 AWG copper conductor and joint to switch operating handle ground wires.
- .3 Connect the operating handle of the switch to the handle base with # 3/0 AWG extra flexible copper conductor.

3.6 POLE MOUNTED TRANSFORMER GROUNDING

- .1 Provide ground rods at the base of each pole on which transformers are mounted and interconnect the rods with the transformer, system neutral, and lightning arrestors.

3.7 GROUNDING IN MANHOLES

- .1 Provide a conveniently located grounding stud, electrode, and ground conductor in each electrical manhole. Install the ground rod with lug for the ground connection so that the top of the rod projects through the bottom of the manhole.

3.8 CABLE SHEATH GROUNDING

- .1 Bond single conductor metallic sheathed cables together at one end only. Break the sheath continuity in an approved manner, and provide #6 AWG flexible copper ground conductor soldered (not clamped) to the cable sheath.
- .2 Connect bonded cables to ground with # 2/0 AWG copper conductor.
- .3 and time of the test, the testing company's name, and the testing technician's name and signature.
- .4

3.9 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 FLEXIBLE GALVANIZED STEEL CONDUIT

- .1 Galvanized steel flexible conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit, complete with proper and suitable squeeze type connectors at terminations.

2.5 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.

2.6 RIGID NON-METALLIC (PVC) CONDUIT

- .1 Rigid PVC conduit to CSA C22.2 No. 211.1, RT-4 rated Rigid PVC (Unplasticized) Conduit, complete with heat gun bends in conduit to 50 mm (2") diameter, solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adapters.

2.7 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.

2.8 FLEXIBLE NON-METALLIC POLYETHYLENE CONDUIT

- .1 Polyethylene pipe to CSA B137.1, minimum Series 75, supplied in continuous coils of the proper length.

2.9 EPOXY COATED RIGID GALVANIZED STEEL CONDUIT

- .1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an additional epoxy coating

inside and outside, factory made bends, factory made and threaded fittings and connectors, and terminations made with epoxy coated rigid couplings.

2.10 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.

2.11 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.

2.12 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 conduit exposed outside the building except where rigid PVC conduit is permitted – rigid galvanized steel
 - .5 For short (minimum 450 mm (18"), maximum 600 mm (24") with a 180° loop wherever possible) runs of conduit to motors, distribution transformers, and vibration isolated equipment – flexible galvanized steel liquid-tight conduit
 - .6 At points where conduit crosses building expansion joints – flexible galvanized steel 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 PVC
 - .9 For concealed branch circuit conductors associated isolated power systems – rigid PVC
 - .10 For all conduit except as specified above – EMT
 - .11 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 12 mm (½") diameter.
- .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: 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 90° 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
- .11 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
- .12 Expansion Facilities: Include for the following conduit expansion facilities:
 - .1 Wherever concealed or surface mounted conduit extends across a building expansion joint,

- provide expansion facilities to permit free movement without imposing additional stress or loading on the support system, and to prevent excessive movement at joints and connections.
- .2 Provide manufactured expansion joint fittings in rigid PVC conduit at spacing recommended by the expansion joint fitting manufacturer
- .3 Install underground flexible polyethylene conduit “snaked” in the trench
- .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/or product data sheets for contactors and accessories. Ensure that the shop drawings and product data sheets indicate all features of the contactors to confirm that the equipment is in accordance with requirements of this Section, including:
 - .1 Enclosure rating
 - .2 Short circuit withstand rating
 - .3 Nameplate information and a schematic wiring diagram
- .2 Start-Up and Site Certification Reports: Submit start-up and site certification reports as specified in Part 3 of this Section.

2 PRODUCTS

2.1 CONTACTORS

- .1 Modular design, factory assembled, electrically held (unless otherwise noted), full size contactors in accordance with requirements of CSA C22.2 No. 14, Industrial Control Equipment, NEMA/EEMAC-1CS, Industrial Controls and Systems, UL 60947-4-1A, Low Voltage Switchgear and Controlgear-Part 4-1:Contactors and motor-starters-electromechanical contactors and motor-starters, and drawing requirements. Unless otherwise shown or specified each contactor is to be complete with a nameplate and the following:
 - .1 A padlockable enclosure with conduit knockouts and mounting screw holes conforming to requirements specified below
 - .2 Enclosed contacts with closed contact indication
 - .3 Unless otherwise indicated, two NC and two NC auxiliary plug-in contacts
 - .4 A continuously rated interchangeable coil
 - .5 Side access, finger-safe field wiring terminals to suit conductors indicated
 - .6 A manual operator
 - .7 Half size contactors not acceptable
- .2 Enclosures: Unless otherwise specified, contactor 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
- .3 Acceptable Manufacturers: Acceptable manufacturers are:
 - .1 Rockwell Automation (Allen-Bradley)
 - .2 Schneider Electric Ltd. (Square D)
 - .3 Siemens Canada
 - .4 Eaton Corp. (Cutler-Hammer)

3 EXECUTION

3.1 INSTALLATION OF CONTACTORS

- .1 Provide contactors where shown and secure in place.
- .2 Connect each contactor with wiring in conduit in accordance with drawing requirements.
- .3 Do all required interlocking work in accordance with drawing control diagram and control sequence requirements.
- .4 When contactor installation is complete, arrange and pay for the manufacturer to visit the site to check the installation, and to supervise all required testing and adjusting. Submit a copy of a report from the manufacturer which certifies that each contactor has been properly installed and connected, and has

been checked and adjusted, as specified in Part 1 of this Section.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Shop Drawings and Product Data: Submit shop drawings and product data sheets for motor starters and accessories. Ensure that the shop drawings and product data sheets indicate all features of the starters to confirm that the equipment is in accordance with requirements of this Section.

2 PRODUCTS

2.1 MOTOR STARTERS AND ACCESSORIES

- .1 General: All motor starters are to be CSA Certified; EEMAC rated, must be capable of starting the associated motors under the imposed loads, and must be suitable in all respects for the motor. Confirm that starter voltages match the motors prior to ordering. IEC and half size starters and contactors are not acceptable.
- .2 Magnetic starters and contactors to be complete with 100VA or larger 120V individual control transformers protected by control fuses.
- .3 Three phase starters and contactors minimum EEMAC size 1.
- .4 Single phase starters and contactors minimum EEMAC size 0.
- .5 All three phase starters shall be complete with single phase protection.
- .6 Starters For Three Phase Motors Less Than 30 HP: Unless otherwise specified, starters for three phase motors less than 30 HP are to be combination "quick-make" and "quick-break" fused door interlock disconnects and full voltage non-reversing across-the-line starters, each complete with solid-state overload relay per phase, an enclosure to suit the application, and, a "hand-off-automatic" switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per the motor starter schedule.
- .7 Motor Starter Enclosures: Unless otherwise specified, motor starter 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 recess type with brushed stainless steel faceplate
- .8 Acceptable Manufacturers: Acceptable manufacturers are:
 - .1 Rockwell Automation (Allen-Bradley)
 - .2 Schneider Electric Ltd. (Square D)
 - .3 Siemens Canada
 - .4 Eaton Corp. (Cutler-Hammer)

3 EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS AND ACCESSORIES

- .1 Provide motor starters for mechanical equipment, except for starters integral with packaged equipment, and starters factory installed in equipment power and control panels. Refer to Mechanical/Electrical Equipment Schedule.
- .2 Single Phase Motor Starters: Unless otherwise specified or shown on the drawings, mount single phase motor starters adjacent to the equipment they serve and connect complete.
- .3 Electrical Wiring for Mechanical Work: Refer to the Section entitled Electrical Wiring For Mechanical Work.
- .4 Set ramp-up and ramp-down times for soft-start type starters as site directed.

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)
- .5 Elevator Disconnect Switches
 - .1 Disconnect in accordance with item 2.1 and complete with auxiliary interlock to disable emergency power lowering of elevator when switch is open, as required by CAN/ULC-B44-00 and associated Supplements.
 - .2 Auxiliary interlock manufacturers:
 - .1 Commander #AS60-IED, 30 to 100 amp.
 - .2 Commander #AS200-I, 200 amp.
 - .3 FPL #E1K-EV, 30 to 100 amp.
 - .4 FPL #E1K-2-EV, 200 amp.
 - .5 Cutler Hammer
 - .3 Provide fusing in accordance with elevator nameplate rating.

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 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 4") 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 Acceptable manufacturers are:
 - .1 Canadian Electrical Raceways Inc.
 - .2 Cooper B-Line
 - .3 Legrand-Cablofil
 - .4 Thomas & Betts

2.2 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: Submit shop drawings and product data sheets for metal raceway, devices, and accessories. Include data to confirm that the raceway 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 raceway layout and relationships between components and adjacent structural, architectural, and mechanical elements.
- .3 Samples: If requested, submit a sample of the raceway to be supplied.
- .4 Colour Chart: If more than one raceway finish colour is available, submit the manufacturer's colour chart.

1.2 QUALITY ASSURANCE

- .1 All metal raceway is to be CSA certified in accordance with CAN/CSA C22.2 No. 62, Surface Raceway Systems, and ULC listed.

2 PRODUCTS

2.1 SURFACE METAL RACEWAY

- .1 Surface mounting, one or two-piece design metal raceway sized as shown and/or specified, constructed of minimum 1 mm (0.040") thick steel, one or two-piece design consisting of a base and snap-on cover, or three-piece design with two snap-on covers side-by-side on a common base, and the raceway is to be complete with:
 - .1 All required fittings and accessories including internal and external corners, couplings for joining raceway sections, wire clips, blank end fittings, and device mounting brackets and plates as applicable
 - .2 A factory applied ivory or gray enamel finish, as indicated
 - .3 125 volt, Specification Grade duplex u-ground receptacles with faceplates as specified in this Division of the Specification
 - .4 Data/communication devices as specified
 - .5 Factory installed power/data/communication wiring as specified in this Division of the Specification
- .2 Acceptable manufacturers are:
 - .1 Legrand-Wiremold
 - .2 Canadian Electrical Raceways Inc.
 - .3 Hubbell/Bryant
 - .4 Schneider Electric/Square D
 - .5 Panduit Corp.

3 EXECUTION

3.1 INSTALLATION OF METAL RACEWAY

- .1 Provide surface metal raceway where shown, complete with all required fittings, devices, and all required accessories. Site measure for proper lengths.
- .2 Accurately locate the raceway and secure in place in accordance with the manufacturer's instructions, level and plumb.
- .3 Where possible, butt raceway end to adjacent walls, cabinets, millwork, and similar items.
- .4 Do not exceed the raceway manufacturer's wire fill requirements.
- .5 Coordinate requirements for network data cabling and/or communication system wiring with the work of the Section where such items are specified.
- .6 Test raceway to ensure proper operation of devices, and electrical continuity of bonding and grounding connections.

.7 Provide barriers where required.

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 Rigid PVC outlet boxes
 - .3 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

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 Rigid plastic (PVC), junction boxes and access fittings with solvent weld type joints and screw-on PVC covers

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 Rigid PVC Boxes In New Concrete Slabs: Provide rigid PVC outlet boxes in locations as follows:
 - .1 In underground polyethylene conduit systems
 - .2 For rigid PVC conduit systems where permitted
- .5 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.
- .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 stainless steel 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 90° 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 gasketed boxes unless otherwise noted
 - .3 In plastic conduit – rigid PVC boxes
- .4 All pull boxes and junction boxes must be accessible after the work is 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

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, 15 ampere, 120-277 volt A.C. quiet action rocker switches, single pole, 2-pole, 3-way and 4-way 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 Decorative Wall Rocker Switch: Generally as specified above for standard toggle switches but rectangular decorative rocker type with rocker handles.
 - .2 Motor Control Snap Action Switch: Illuminated handle snap action horsepower rated switch CSA certified for motor control and sized to suit the application.

2.2 OCCUPANCY SENSOR SWITCHES

- .1 Combination passive infrared and ultrasonic sensor/switch assemblies with a rating to suit the connected load, wall (180° coverage) and/or ceiling mounted (360° coverage) as indicated on the drawings, white, almond or ivory colour as directed, each complete with time, range and light adjustments, adjustable blinders to block peripheral signals, a photocell to detect light to enable ambient light override, Fresnel lens, LED indicator which flashes when the sensor detects motion, and a manual on-off push button.

2.3 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

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 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:
- .1 Type 302/304 stainless steel switch and receptacle faceplates, satin finish as directed, with stainless steel screws
 - .2 NEMA 3 rated, single gang, horizontal/vertical mounting, weather-proof in use, gasketed cast aluminum receptacle faceplates to suit the type of receptacle used
 - .3 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 'Decorator' switches and receptacles in finished areas, non-essential circuits: white
- .2 Switches and receptacles in unfinished areas, non-essential circuits: white stainless steel faceplates
- .3 .
- .4 Weather-proof receptacles: cast aluminum gasketed weather-proof faceplates to suit the type of receptacle installed.
- .5 Weather-proof switches and weather-proof gray neoprene press-switch plate and press switch.
- .6 Faceplates materials: stainless steel 302/304 satin finish

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
 - .4 Panel interiors shall be painted white.
- .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 40° C (105° 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
- .4 Modifications & Accessories: Where indicated on the drawings or scheduled, 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
- .2 200% neutrals for panelboards equipped with SPD units and other panels as scheduled
- .3 Isolated ground bus for panelboards feeding electrically sensitive equipment and as scheduled
- .4 Insulated ground bus assembly
- .5 Sub-feed lugs
- .6 Through-feed lugs
- .7 A non-automatic or automatic (as scheduled) main breaker
- .8 A shunt trip for the main breaker
- .5 Acceptable Manufacturers: Acceptable manufacturers are:
 - .1 Schneider Electric (Square D)
 - .2 Eaton Corp. (Cutler-Hammer)
 - .3 Siemens Electric Ltd.

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 In addition to load circuit breakers scheduled and indicated for each normal power panelboard, provide five 15A-1P additional breakers for small power and miscellaneous mechanical loads, each connected with 30 m (100') of 19 mm (3/4") dia. EMT and two #12 AWG plus ground, with terminations as directed during construction.
- .5 Provide additional devices and accessories for panelboards as indicated and/or scheduled.
- .6 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.
- .7 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.
- .8 Provide 25% spare breakers in each panel based on number of circuits in use.
- .9 Provide 25% breaker spaces in each panel based on number of circuits in use.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- .1 This section includes the following items:
 - .1 Engine Generator Set.
 - .2 Enclosure
 - .3 Related Accessories as specified
- 1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
- 2. KOHLER model 300 is the basis of design, any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been omitted or have been taken exception to, and a complete description of all deviations.
- 3. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
- 4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.
- 5. The emergency standby generator system shall consist of one natural gas electric generator set and controls, size as shown on drawings. The emergency generator set will start up during the loss of normal utility power supply and to run the life safety systems in the building.
- 6. Generator set consists of a natural gas engine prime mover, alternator, engine mounted control panel, starting battery with charger and direct connected radiator/fan assembly all mounted on a common structural steel base.
- 7. The system shall also include a gas supply system, exhaust system and automatic engine room ventilation system, as indicated on the plans.
- 8. Generator set shall be self-contained outdoor level 2 sound attenuated steel enclosure c/w structural steel mounting base and shall not exceed 70 dBA at 7 metres from the source, measured in free-field conditions at full load operation.

1.2 SUBMITTALS

- .1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for the engine-generator set and all accessories. Ensure that the shop drawings and product data sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section. Shop drawings and product data sheets are to be submitted for:
- .2 The engine and the generator (alternator) and associated engine coolant components with weights, dimensions, electrical characteristics and all performance data, and installation instructions and diagrams for wiring and piping
 - .1 The control panel, including a control wiring schematic, and a description of control panel sequences and integration with other building systems
 - .2 Engine-generator set sound pressure levels under full load

- .3 Engine exhaust components
- .4 Certificates.
- .5 Test and Evaluation Reports
- .6 Manufacturer's Instruction
- .7 Source Quality Control Submittals
- .8 Field or Site Quality Control
- .9 Manufacturer's Report
- .10 Special Procedure Submittal
- .11 Qualification Statement
- .3 Engine Exhaust System Review and Confirmation: Submit a letter from the engine-generator set manufacturer which confirms that the engine exhaust system design and layout, including backpressure, is suitable for proper operation of the set.
- .4 Engine-Generator Set Vibration Analysis: Submit an engine-generator set torsional vibration analysis and a critical vibration analysis prepared by the set manufacturer.
- .5 Emission Summary Report: Submit emission summary report which confirms compliance with the requirements of MOECC, O. Reg. 419/05, Air Pollution – Local Air Quality.
- .6 Factory Testing and Test Report: Include for all travel costs for a representative of the Owner and Consultant to witness a successful factory test on the engine-generator set at rated load and power factor prior to shipment to the site. The factory test must also include all demonstration of proper operation of all operating and safety controls and sequences Submit a dated and signed copy of the factory test report.
- .7 Spare Parts and Maintenance Supplies: Supply the following spare parts and maintenance supplies:
 - .1 A surface wall mounting identified enameled steel cabinet with shelves, hinged door(s), and keyed lock with a minimum of three identified keys
 - .2 Six fuel oil filter elements with gaskets
 - .3 Six lubricating oil filter elements with gaskets
 - .4 Six air filters elements
 - .5 Two complete sets of spare fuses
 - .6 Two complete and identified sets of spare lamps for all indicating and warning lights
 - .7 One complete set of spare belts
 - .8 A litre of touch up paint for each colour/type of finish used on the set
 - .9 Any special service and/or maintenance tools
- .8 Manufacturer's Inspection & Certification & Start-Up & Test Reports: Submit a report from the generator set manufacturer to confirm that the manufacturer has inspected the completed generator set installation and found it acceptable, and a report documenting that he has supervised successful start-up and adjustment of the equipment, all as specified in Part 3 of this Section.
- .9 Operation and Maintenance Training: When on-site maintenance and training is complete, supply and hand to the Owner digital copy O&M outlining complete operation and maintenance procedures.
- .10 Control Panel Keys: Submit a minimum of three identified keys for the engine-generator set control panel door.
- .11 Closeout Submittal: Maintenance Contracts, Operation And Maintenance Data and Warranty Documentation
- .12 Load bank connection box.
- .13 Supply decrement and damage curves plotted against breaker trip curves to show proper co-ordination over the full range of alternator output.
- .14 Generator enclosure.
- .15 Maintenance Material Submittals: Provide one (1) copy of the following documents and manuals for the engine, the alternator, and the generator set:
 - .1 Operation Manuals
 - .2 Parts Catalogs
 - .3 Wiring Diagrams.

1.3 QUALITY ASSURANCE

- .1 The engine-generator set(s) is to be in accordance with requirements of the following:

- .1 CSA 282, Emergency Electrical Power Supply for Buildings
- .2 CSA C22.2 No. 107.2, Battery Chargers

1.4 ACCEPTABLE MANUFACTURERS/SUPPLIERS

- .1 Acceptable generator set manufacturers/suppliers are:
 - .1 Cummins Eastern Canada LP
 - .2 Kohler
 - .3 Sommers Generator Systems

1.5 ON-SITE TRAINING

- .1 The engine-generator set manufacturer/supplier is to provide a minimum eight hour on-site training session for four members of the Owner's designated personnel on generator set operation and maintenance procedures. The Operating and Maintenance Manuals are to be used during this training, and a digital copy of the recording of the session is to be handed to the Owner upon completion.

1.6 ON-SITE ONE YEAR SERVICE AND MAINTENANCE

- .1 Include for supplying a generator set supplier's qualified service representative for the following on-site engine-generator set service and maintenance for one year following Substantial Performance of the work:
 - .1 twenty-four hour, seven day a week emergency repair service with a maximum two hour response time
 - .2 all required service and maintenance in accordance with requirements of the O & M Manual, including at least one oil and filter change, and supply of all consumables
 - .3 at the end of the one year period, an inspection and test in accordance with CAN/CSA-C282, Annual Inspection Test and Maintenance Requirements
- .2 Notify the Owner forty-eight hours in advance of each site visit for service and maintenance procedures. One or more Owner's personnel will accompany the service representative during each visit to gain further knowledge re: service and maintenance procedures.

1.7 WARRANTY

- .1 With the exception of the engine, which shall be guaranteed for three years, the complete generator set, including all controls and auxiliaries, shall be guaranteed for a period of one year, or 2000 hours of operation from date of acceptance to be free from defects in workmanship and material.
- .2 All repairs made under this guarantee shall be done at no expense to the Owner, including travel time and expenses.
- .3 As part of warranty obligations, include all costs for providing temporary engine generator set at the site, within four hours of notification by the Owner and failure of a service technician to rectify an operating problem, a fully connected and operating temporary engine-generator set of equal capacity and performance of the specified engine-generator set, should any engine-generator set component failure occur that would prevent the set from operating properly at full capacity.

1.8 PERMIT, FEES, AND INSPECTION

- .1 Obtain all permits, make submissions, pay all fees including variance applications and arrange for all inspections required for the work of this Division.
- .2 Contractor to schedule and pay for a pre-construction review with the local Authority Having Jurisdiction onsite prior to commencement of work. Report back to consultant with all discrepancies noted during the pre-construction review and the contract documents.
- .3 Contractor to schedule and pay for all post construction reviews with the local Authority Having Jurisdiction to confirm compliance. Once authorities have reviewed and approved the construction work, all certificates and reports to be turned over to the owner.

2 PRODUCTS

2.1 ENGINE-GENERATOR SET

- .1 Factory assembled and tested, radiator cooled, natural gas engine driven electric generator set equipped with all required controls and accessories to comprise an automatic, standby and prime electric generating plant to perform under conditions specified below. The engine-generator set must be suitable in all respects for installation in the space provided.
- .2 Performance Requirements: The engine-generator set is to meet frequency and voltage requirements specified in the referenced CSA Standard, The engine-generator set is to automatically start in the event of commercial power failure, automatically stop when commercial power is restored, and be capable of operating with loads for an extended period of time, and performance criteria is to include the following:
 - .1 The engine-generator set is to be capable of operating with a single full load step for the nameplate kilowatt rating within the CSA Standard voltage and frequency regulation requirements without stalling and without a voltage drop below 75% of normal
 - .2 It shall provide 325 kVA 120/208 volts, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby @40C rating while operating in an ambient condition of less than or equal to 77 °F and a maximum elevation of 500 ft above sea level. The standby rating shall be available for the duration of the outage.
 - .3 The minimum 14.6-liter displacement 4-cycle turbocharged and aftercooled engine shall deliver a minimum of 402 HP at rated rpm 1800 rpm, and shall be equipped with the following:
 - a. Electronic isochronous governor capable of 1.0% steady-state frequency regulation
 - b. 12-volt positive-engagement solenoid shift-starting motor
 - c. 130-ampere automatic battery charging alternator with a solid-state voltage regulation and negative ground polarity
 - d. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
 - e. Dry-type replaceable air cleaner elements for normal applications
 - f. The engine shall be turbocharged and fueled by Natural Gas
 - g. Operating fuel pressure for natural gas shall be between 12.0 and 15.0 inches of H2O
 - h. Natural gas fuel consumption at 100% load shall not exceed 2782 cubic feet per hour when operating in standby configuration
 - i. The exhaust manifold shall be dry.
 - j. Exhaust flow shall not exceed 1611 cubic feet per minute at rated kW.
 - k. Exhaust temp shall not exceed 1112 F at rated kW.
 - l. The engine shall have a minimum of 8 cylinders in a V configuration and be liquid-cooled
 - .4 The engine shall be EPA certified from the factory
 - .5 The generator must accept rated load in one-step.
- .3 Fabrication Requirements: Engine-generator set fabrication requirements include the following:
 - .1 If required by conditions, the set must be delivered to the site in sub-assemblies suitable for moving the set to the final location and assembled on site by manufacturer
 - .2 All moving parts such as flywheels, belts, etc., are to be protected by removable OSHA guards
 - .3 All "hot" parts of the set such as exhaust manifolds and the flexible exhaust connection which are located where they might be touched by personnel during normal service or maintenance procedures are to be protected by guards, or be factory insulated with minimum 50 mm (2") thick removable/replaceable insulating material
 - .4 The engine flywheel housing is to be connected to the generator housing with a SAE adaptor and the engine-generator set is to be aligned and secured to a common, rigid, welded, stress relieved, structural steel enameled base capable of maintaining alignment of the engine-generator shafts and frames under all conditions including shipping, and the manufacturer/supplier is to obtain and submit torsional approval of the assembly from the diesel engine manufacturer
 - .5 Engine-generator mounting feet and steel base sole plates are to be machined parallel and

- true, and steel shims will be permitted only underneath the generator feet if required
- .6 Minimum 95% isolation efficiency cast iron housed steel spring vibration isolators with leveling bolts, oil-proof snubbers, minimum 6 mm (¼") thick sound pads, and seismic restraints as required by Code are to be supplied with the engine-generator set
- .7 Engine mounted accessories are to be readily removable without dismantling any part of the assembly
- .8 Engine air intake: replaceable element dry vortex type engine air intake filters, and air box drain canisters which shall be mounted on the generator set directly connected to the turbocharger inlet.
- .9 Engine exhaust system: engine exhaust system components designed to meet MOECC requirements are to be supplied loose with the set for site installation and are to include:
 - .1 A welded black steel pipe exhaust manifold "Y" fitting
 - .2 Minimum 600 mm (24") long flexible stainless steel exhaust pipe sections
- .4 Cooling System The engine shall be liquid-cooled by a closed loop, unit mounted radiator rated to operate the generator set at full load at an ambient temperature of 50 degrees C (122 degrees F). The radiator fan and other rotating engine parts shall be guarded against accidental contact. The cooling water temperature during engine operation shall be controlled by an automatic, modulated valve, pre-piped in the engine cooling loop, which shall control the flow of coolant through the radiator. This valve shall also provide for fast engine warm-up and a constant flow of engine coolant.
- .5
- .6 Standard Air Cleaner: The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.
- .7 Battery: Each genset requires a maintenance free BCI group 24 battery which must meet the engine manufactures' specifications for the ambient conditions specified in Part 1 Project Conditions and shall comply with the NFPA requirements for engine cranking cycles. This battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 650 amps and a minimum reserve capacity of 120 Minutes at 80F. The battery plates shall be constructed of a Calcium-Lead alloy to provide long waterless operation and extended battery life. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.
- .8 Housing
 - .1 Level 2 Sound Attenuated Aluminum Enclosure
 - .1 The generator set shall be supplied with a standard steel weather enclosure from same manufacturer.
- .9 An auxiliary remote control connection terminal block assembly, clearly identified and including:
 - .1 Contacts for engine alarm signal for remote annunciation of engine faults, failure, and alarms
- .10 Permanently affixed, suitably sized, engraved Lamacoid nameplates for all control panel devices, switches, meters, lights, and other items, with wording approved by the Consultant
 - .1 All required relays, contacts, and similar hardware required for connections to the building automation system as per the automation system points list, all to suit BAS protocol
- .11 Remote Annunciator Panel:
 - .1 NEMA 1 with LCD digital displays to allow for remote monitoring of genset. Controls and monitoring features are to be compatible with the building automation system and include but not limited to the following:
 - .1 LED type shut-down and warning indicating lights (brilliant cluster type for LED's that are continuously illuminated) for the following:
 - .1 High oil temperature – red for shut-down, amber for warning
 - .2 High coolant temperature – red for shut-down, amber for warning
 - .3 Low oil pressure – red for shut-down, amber for warning
 - .4 Over crank shut-down – red
 - .5 Over speed shutdown – red
 - .6 Over voltage shut-down – red

- .7 Selector switch "NOT IN AUTO" warning – amber
- .8 Low DC voltage warning – amber (c/w DC voltage sensor)
- .9 Engine cool-down period indication – white
- .10 Reverse power shut-down – red
- .11 Under voltage shut-down – red
- .12 Low frequency shut-down – red
- .13 High frequency shut-down – red
- .14 Low coolant level warning – amber
- .15 Low fuel level warning – amber
- .16 Battery charger failure warning – amber
- .17 Water in fuel warning – amber
- .18 Emergency power bus alive indication – blue
- .19 Generator bus alive warning – amber
- .20 ECS not in auto warning – amber
- .21 Low engine temperature warning - amber
- .22 Audible alarm silence warning – amber
- .23 Alternator winding/bearing high temperature warning – amber
- .24 Fuel leakage warning – amber
- .25 Ground fault warning – amber
- .26 Auxiliary building alarms as specified and/or shown
- .27 Two spare lights for future use
- .28 Lamp test
- .29 Contacts for local and remote common alarm
- .30 Main disconnect open
- .31 Emergency electrical power supply system supplying load
- .32 Overcurrent
- .33 Low starting hydraulic pressure (if applicable)
- .34 Air shutdown damper (if applicable)
- .35 Remote emergency stop (if applicable)
- .36 Ventilation dampers not open
- .2 An auxiliary remote control connection terminal block assembly, clearly identified and including:
 - .1 Contacts for engine alarm signal for remote annunciation of engine faults, failure, and alarms
 - .2 Four Form C contacts for signal engine run
 - .3 Four Form C contacts for engine failure
 - .4 One Form C contact for engine failure
- .3 Permanently affixed, suitably sized, engraved Lamacoid nameplates for all annunciator panels with wording approved by the Consultant
- .4 All required relays, contacts, and similar hardware required for connections to the building automation system as per the automation system points list, all to suit BAS protocol
- .12 Emergency Power Off Push Button: Equal to Rockwell Automation/Allen-Bradley 800T Series 55 mm (2¼ ") diameter red mushroom head push button with shroud, thrust washer, and aluminum faceplate with 'EMERGENCY POWER OFF' identification wording, housed in a flip-open polycarbonate tamper-proof cover.
- .13 Controller
 - .1 Advanced Power Management 402 (APM402) Generator Set Controller
 - .1 The generator set controller shall be a microprocessor-based control system that will provide automatic starting, system monitoring, and protection.
 - .2 The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.
 - .2 Codes and Standards
 - .1 The generator set controller shall meet CSA-282-19 and NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
 - .2 The controller shall meet NFPA 99 and NEC requirements.

- .3 The controller shall be UL 508 recognized.
- .3 Applicability
 - .1 The controller shall be a standard offering in the manufacturer's controller product line.
 - .2 The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
- .4 Controller Buttons, Display, and Components
 - .1 The generator set controller shall include the following features and functions:
 - .1 Master Control Push Buttons – the buttons shall be tactile-feel membrane with an indicator light to initiate the following functions:
 - o Run Mode – when in Run mode the generator set shall start.
 - o Off/Reset Mode – when in Off/Reset mode, the generator set shall not accept any remote start commands and shall be capable of resetting all faults, allowing for the restarting of the generator set after a shutdown.
 - o Auto Mode – when in Auto mode, the generator set shall be ready to accept a signal from a remote device.
 - .2 Emergency Stop Switch – the latch type stop switch shall be red in color with a “mushroom” type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
 - .3 Alarm Horn – the horn sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the Auto mode.
 - .4 Push Button/Rotary Selector Dial – the dial shall be used for selection of all menus and sub-menus. Rotating the dial moves through the menus, pushing the dial selects the menu and function/features in the menu.
 - .5 Display – the digital display shall be alphanumeric, with 2 lines of data and approximately 24 characters. The display shall have back lighting for ease of operator use in high and low light conditions. The display shall enter a sleep mode to reduce the demand on the battery when the generator set is not running, and the rotary dial is not in use for a period of time. The generator will wake up from sleep mode when the generator set starts, or the rotary dial is in use.
 - .6 Fault Light – the controller shall have an annunciator fault light that glows red for faults and yellow for warnings. The warning light will also illuminate when not in Auto.
 - .7 Alarm Silence/Lamp Test Button – when this button is held, it shall test all controller lamps. This button will also silence the alarm horn when the unit is not Auto or has a fault.
 - .8 Mini-USB Connection – the controller shall have a mini-USB connection port for a PC connection that is accessible on the front of the control panel without having to open any electrical enclosure panels on the generator. This connection shall allow a certified technician to service the generator controller using a dedicated PC program. The program shall allow for servicing of generator set parameters, faults diagnostics and viewing of controller information. The program shall allow for uploading of software and firmware as well as downloading of parameter settings and the event log.
 - .5 Controller Engine Control Features and Functions
 - .1 User-programmable time delay for engine start.
 - .2 User-programmable time delay engine cool down.
 - .3 Capability to start and run at user-adjustable idle speed during warm-up for a selectable time-period until engine reaches preprogrammed temperature.
 - .4 The idle function including engine cooldown at idle speed.
 - .5 Output with adjustable timer for an ether injection starting system.
 - .6 Programmable cyclic cranking that can adjust on time, off time, and number of cycles.
 - .6 Controller Alternator Control Features and Functions
 - .1 Patented High-speed RMS Digital Voltage Regulation – the system shall have integral microprocessor-based voltage regulator system that provides + 0.5% voltage regulation no-load to full load with three phase sensing. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-

- phase systems. The system shall be prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum + 10% adjustable of nominal voltage.
- .2 Alternator Thermal Overload Protection – the system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
- .7 Other Control Features and Functions
- .1 Event Logging – the controller keeps a record of up to 1,000 events with date and time locally for warning and shutdown faults. This event log can be downloaded onto a PC through the service program.
- .8 Control Monitoring Requirements
- .1 The generator controller shall display and monitor the following engine and alternator functions.
 - i. The following generator set functions shall be monitored:
 - 1. All output voltages - single phase, three phase, line to line, and line to neutral
 - 2. All single phase and three phase currents
 - 3. Output frequency
 - 4. kVA total and per phase
 - 5. kW hours
 - ii. Engine parameters listed below shall be monitored (engine dependent):
 - 1. Engine Speed
 - 2. Oil Pressure
 - 3. Coolant Temperature
 - 4. Battery Voltage
 - 5. Runtime Hours
 - 6. Fuel Pressure or Level
 - 7. Fuel Consumption Rate
 - iii. Operational records shall be stored in the control beginning at system startup
 - 1. Total Run Time Hours
 - 2. Total Loaded Hours
 - 3. Total kW Hours
 - 4. Number of Starts
 - iv. For maintenance and service purposes, the controller shall store and display on demand the information:
 - 1. Generator Model
 - 2. Generator Serial Number
 - 3. Controller Serial Number
- .9 Generator Set Warning, Shutdown Alarm and Status
- .1 The generator set shall have alarms and status indication lamps that show Non-Automatic Status, Warning, and Shutdown conditions. The controller shall indicate with a warning lamp and/or alarm, and on the digital display screen any shutdown, warning, or engine fault condition that exists in the generator set system.
 - .2 Conditions, as a minimum, resulting in generator shutdown (engine dependent):
 - 1. AC Sensing Loss
 - 2. Alternator Protection
 - 3. ECM Address Conflict
 - 4. ECM Communications Loss
 - 5. ECM DTCs
 - 6. Emergence Stop
 - 7. Overspeed
 - 8. Underspeed
 - 9. High Coolant Temperature
 - 10. kW Overload
 - 11. Locked Rotor
 - 12. Loss of Fuel
 - 13. Low Coolant Level

- 14. Low Engine Oil Level
- 15. Low Fuel Level
- 16. Low Oil Pressure
- 17. No Coolant Temperature Signal
- 18. No Oil Pressure Signal
- 19. Overcrank
- 20. Overfrequency
- 21. Underfrequency
- 22. Overvoltage
- 23. Undervoltage
- .3 Conditions, as a minimum, resulting in generator warning (generator will continue to operate) (engine dependent):
 - 1. AC Sensing Loss (short period of time)
 - 2. Battery Charger Communication Loss
 - 3. Battery Charger Fault
 - 4. Battery Fault
 - 5. Critical High Fuel Level
 - 6. High Fuel Level
 - 7. Low Fuel Level or Pressure
 - 8. Fuel Tank Leak
 - 9. Ground Fault
 - 10. High Battery Voltage
 - 11. Low Battery Voltage
 - 12. Low Cranking Voltage
 - 13. High Coolant Temperature
 - 14. Low Coolant Temperature
 - 15. Low Engine Oil Level
 - 16. Low Oil Pressure
 - 17. Not in Auto
 - 18. Speed Sensor Fault
 - 19. ECM DTCs
- .4 Inputs and Outputs
 - 20. Standard Dedicated User Inputs – the controller shall have dedicated inputs for:
 - o Two-Wire Input
 - 4. Remote Engine Start
 - o Digital Input - Fixed
 - 5. Auxiliary Fault (Shutdown)
 - 6. Remote Emergency Stop
 - o Digital Input – Programmable
 - 7. 3 Dry Contact
- .5 Standard Dedicated User Outputs – the controller shall have dedicated outputs for:
 - Relay Driver Output - Programmable
 - 1. 1 Relay
- .6 Optional Configurable User Inputs and Outputs
 - 1. User Configurable Inputs
 - 2. 2 Dry Contact Digital
- .7 User Configurable Relay Outputs
 - 3. 5 NO/NC Relays
- .10 Communications
 - .1 CAN
 - 1. If the generator set engine is equipped with an ECM, the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
 - .2 Modbus®
 - 1. Isolated for Modbus devices
 - .3 BACnet

- .14 Generator Overcurrent and Fault Protection
 - .1 The generator shall be provided with a factory installed, 80% rated line circuit breaker rated at 370 amperes that is UL489 listed. Line circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC.
 - .2 The generator shall be provided with a 2nd factory installed, 80% rated line circuit breaker rated at 800.00 amperes that is UL489 listed. The 2nd circuit breaker to be used for load bank testing and shall come complete with shunt trip.
 - .3 The circuit breaker(s) shall incorporate a thermo-magnetic trip unit.
 - .4 Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections.
 - .5 The shunt trip device shall be connected to trip the generator breaker when the generator-set is shut down by other protective devices.
 - .6 When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the other generator-set alarms.
 - .7 Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.
- .15 Alternator
 - .1 The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby @40C. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid-state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
 - .2 The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
 - .3 The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.
 - .4 Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 540.00 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.
- .16 Vibration Isolation
 - .1 Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.
- .17 Accessories
 - .1 The generator set shall be supplied with a 6-ampere automatic float/equalize battery charger capable of charging both lead-acid and gel-cell type batteries, with the following features:
 - i. Automatic 3-stage float to equalization charge
 - ii. 1% steady-state voltage regulation from no load to full load over 10% AC input line voltage variation
 - iii. Indicator LED lamps for charge state indication (bulk charge/absorption/float)
 - iv. Ambient temperature operating range: -40°C to 70°C
 - v. Potting for durability and waterproofing

- vi. Short-circuit and reverse polarity protection
- vii. UL 1236 listed
- viii. UL 2200 compliant
- ix. CSA certified
- x. Ring terminals for battery connection.
- .2 The generator set shall be furnished with rodent guards to prevent rodent intrusion and protect internal components.
- .3 The generator set shall be provided with a run relay which shall provide a three-pole, double-throw relay with 10-amp/ 250 VAC contacts to indicate that the generator is running. The run relay dry contacts can be used for energizing or de-energizing customer devices while the generator is running (e.g. louvers, indicator lamps, etc.)
- .4 Block Heater - The block heater shall be thermostatically controlled, 1,500 watt, 110-120 VAC - single phase, to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.
- .5 The controller must have the capability to communicate to a personal computer (IBM or compatible) running Windows '9X, Windows XT, Windows 7, Windows 8, or Windows NT.
- .6 A variety of connections shall be available based on requirements:
 - i. A single connection to a PC. A cable length of up to 1220 m (4000 ft) must be supported.
 - ii. Multiple devices at a single location connected to a PC.
 - iii. A single connection from a device to a PC over phone lines.
 - iv. Multiple devices to a PC over phone lines.
- .7 When equipped with communications modules, transfer switches and power monitors along with generator set controllers must be able to be connected to the same communication network with no additional interfaces being required.
- .8 The capability to connect up to 128 devices (generator set controls and transfer switches) on a single network must be supported.
- .9 Cabling is to be device to device in a daisy chain fashion with no limitation on device locations within the network.
- .10 The network must be self- powered. No power wiring between devices is allowed.
- .11 A single software package with the following capabilities is required:
 - i. Any combination of transfer switches and generator set controls.
 - ii. Up to 128 devices at a single site must be supported.
 - iii. The same software package must support communications over phone lines. The software shall allow communications with up to 128 sites (phone numbers) including phone number fields large enough for International communication.
 - iv. Access to individual devices by the software shall be protected by password.
 - v. To support future expansion, it must be possible to add devices (ATS and generator set controllers), up to 128 and sites up to 128, with the installed software. Changing to a different software package is not acceptable.
 - vi. All displays, data inquires, and program functions allowed on the controllers, both generator set and ATS, shall also be available through the software.
 - vii. A single software screen must be capable of displaying data from multiple devices simultaneously.
 - viii. It shall be possible to reset shutdown faults, and restart the generator set using the software.
 - ix. If a transfer switch is used, it must be possible to start the generator set and transfer the loads to the generator.
- .12 The generator set shall be supplied with a 2 Input/5 Output Module kit to provide two additional analog inputs and 5 additional dry contact outputs. The analog inputs can be used for analog or digital input functions. They can be set up for 0-5VDC, ± 3 VDC resistive or relay contact sensor devices. The dry contact outputs shall be arranged as two 120VAC or 28VDC, 10A form C contacts and three 28VDC, 2A form C contacts. Input and output functions are user defined.
- .18 Source Quality Control
- .1 Non-Conforming Work

1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
 - a. **Design Prototype Tests.** Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
 - i. Maximum power (kW)
 - ii. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
 - iii. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
 - iv. Governor speed regulation under steady-state and transient conditions.
 - v. Voltage regulation and generator transient response.
 - vi. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 - vii. Three-phase short circuit tests.
 - viii. Alternator cooling air flow.
 - ix. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
 - x. Endurance testing.
- .2 Final Production Tests. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
 - i. Single-step load pickup
 - ii. Safety shutdown device testing
 - iii. Rated Power @ 0.8 PF
 - iv. Maximum power
 - v. Upon request, a witness test, or a certified test record sent prior to shipment.
- .3 Site Tests. The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
 - i. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
 - ii. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
 - iii. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
 - iv. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.

3 EXECUTION

3.1 INSTALLATION OF ENGINE-GENERATOR SET

- .1 Ensure that the factory tests have been satisfactorily performed prior to delivery of the set to the site.
- .2 Provide a new emergency power engine-generator set where shown. Secure the set in place, level and plumb, on a concrete housekeeping pad on vibration isolators supplied with the set and

- strategically placed such that each isolator will support an equal portion of the weight and the pressure exerted on the structure by each isolator does not exceed 345 kPa (50 psi).
- .3 Check engine-generator alignment after installation on the housekeeping pad and realign if necessary.
 - .4 Provide a drain pan under the engine on the housekeeping pad and between the isolators
 - .5 Carefully coordinate installation of the engine-generator set with the trades installing the flexible fuel oil connection and piping, the flexible exhaust connection, silencer and exhaust piping, and site applied thermal insulation. Ensure that the exhaust piping diameter is in accordance with the engine supplied, and that the location and height of the exhaust stack meets local air and noise limitations.
 - .6 Provide starting batteries, battery rack, and jumper cable to connect the batteries together and to the engine starting system. Provide a wall mounted storage cabinet adjacent the battery rack and containing a hydrometer, syringe, and other accessories.
 - .7 Wall mount the battery charger adjacent to the battery rack and connect to the batteries. Test charger operation and adjust as required.
 - .8 Fill the engine cooling system with a 50% water-50% automotive type ethylene glycol solution. Check the specific gravity of the coolant to confirm proper percentages.
 - .9 Check and test operation of the engine starting system and engine jacket coolant heaters.
 - .10 Check the level of the engine lubricating oil and add oil if required.
 - .11 Surface wall mount an "Emergency Power Off" push button station where shown and connect to the generator set control panel to shut-down the set when the push button is activated. Confirm exact location prior to roughing-in.
 - .12 Do all required control wiring in conduit between the generator set control panel and associated equipment as per the control wiring schematic and the wiring requirements of the electrical work. Check and test all such control functions.
 - .13 Carefully coordinate building automation system connections to the control panel with the trade performing the building automation system work.

3.2 ELECTRICAL CONTRACTOR'S RESPONSIBILITY

- .1 Receiving, hoisting and placing in position of the natural gas generator set and accessories such as exhaust silencer.
- .2 All wiring for systems.
- .3 All wiring for engine accessories such as jacket water heater, lube oil circulating pumps, fuel oil pump, electric governor, etc.
- .4 All main power connections and exciter connections between generator, Emergency Power Control System, and the respective Automatic Transfer Switch.
- .5 All wiring between engine-mounted control panel, Emergency Power Control System DELETE and the respective Automatic Transfer Switch(es).
- .6 All wiring between engine-mounted control panel, Emergency Power Control System DELETE and the respective Fire Pump Transfer Switch(es).
- .7 Installation of starting/control battery and wiring of associated battery charger.

3.3 MECHANICAL CONTRACTOR'S RESPONSIBILITY

- .1 All support steel for exhaust silencer & exhaust piping.
- .2 All exhaust piping.
- .3 Fuel piping from day tanks to fuel transfer connections on the generator set.
- .4 Providing 2 inches of calcium silicate insulation with aluminum wrap over all of the exhaust piping and silencer.

3.4 SITE TESTING, START-UP, AND CERTIFICATION

- .1 When installation of the engine-generator set is complete and initial inspections by the set supplier's representative have been completed, obtain from the supplier's representative and forward to the Consultant a letter to confirm site inspection and proper installation of the equipment.
- .2 Arrange and pay for the set supplier's representative to supervise start-up of the equipment, and

prepare and submit signed start-up reports.

- .3 In addition to testing and verification requirements specified in the Sections entitled Electrical Work Commissioning and Electrical Work Testing, perform testing work as specified below. Notify the Owner and Consultant ten working days in advance of the site testing, and arrange and pay for the set supplier's representative and a journeyman electrician to be on-site to conduct the tests. Prepare and submit signed reports to confirm successful testing results. Site tests are to include:
 - .1 Perform On-Site operational tests in conformance to CAN/CSA-C282 and CAN/CSA-Z32 and as follows:
 - .1 With the engine in a cold start condition and the emergency load at its normal operating level, a power failure shall be simulated by opening all switches or breakers that supply the normal power to the building. The test load shall be that load which is normally served by the emergency power system.
 - .2 The operational test shall be continued for 1 h, after which normal power shall be restored to the building and satisfactory transfer of the load and shutdown of the emergency generator set shall be demonstrated.
 - .3 The following data shall be observed and recorded; record at first load acceptance and every 15 minutes thereafter until completion of the test period.
 - .1 The time delay on start;
 - .2 The cranking time until the engine starts and runs;
 - .3 The time required to come up to operating speed;
 - .4 The time required for each life safety equipment transfer switch to be transferred to the emergency position;
 - .5 The time required to achieve a steady-state condition, with all switches transferred to the emergency position;
 - .6 The time delay(s) for the connection of any loads arranged to be connected to the emergency supply later than the life safety equipment;
 - .7 The voltage, frequency, and amperes at start-up, at any observed change in load, and at full load;
 - .8 the engine oil pressure, water temperature (or other representative engine operating temperature, where applicable, e.g., with air-cooled engines), and the battery charge rate 1 min after start, at 5 min intervals for the first 15 min, and at 15 min intervals thereafter;
 - .9 The time delay on retransfer for each transfer switch; and
 - .10 The time delay on engine cool-down and shutdown.
 - .2 Full Load Test: Following the successful operational test, perform a four hour full load test based on the full load specified by the generator set label. This test must not use the building load. Load banks must be provided by the generator set supplier. The full load test may be initiated by any method that will start the engine and immediately upon reaching full speed, pick-up the full load in one step. Record data for items as listed below for the operational test at full load acceptance and every fifteen minutes thereafter until completion of the test period.
 - .1 Time delay on start
 - .2 Cranking time until the engine starts and runs
 - .3 Time required for the engine to come up to full speed
 - .4 Time required to achieve a steady-state condition with all switches transferred to the emergency position
 - .5 Engine oil pressure, coolant temperature, and battery charge rate at five minute intervals for the first fifteen minutes, and at fifteen minute intervals thereafter
 - .6 Time delay on re-transfer for each transfer switch
 - .7 Time delay for engine cool-down and shut-down
 - .3 Cycle Crank Test: Prevent the engine from running by any means recommended by the set supplier. Put the control switch in the "RUN" position to engage the starting system and cause the engine to attempt to start for a cranking cycle of thirty seconds of continuous cranking or three ten second crank attempts separated by ten seconds. Repeat the crank cycle a second time to demonstrate that the batteries have sufficient capacity for a total cranking time of sixty seconds, then demonstrate the time required to re-charge the batteries.

- .4 Safety Shut-Down and Alarms: Demonstrate that all safety shut-downs and alarms as well as all monitoring points are fully operational. Shutdown tests shall be conducted where possible, with the generator under load conditions.
- .5 Ventilation: During the full load tests, demonstrate that sufficient Generator Room ventilation is provided in accordance with requirements of CAN/CSA-C282.
- .6 Voltage and Frequency: Perform voltage and frequency tests in accordance with requirements of CAN/CSA-C282, as applicable.
- .7 Oil Analysis: Perform oil analysis tests in accordance with requirements of CAN/CSA-C282, as applicable.
- .8 The Electrical Contractor shall be responsible for receiving, placing and connecting and disconnecting the test load banks provided by the manufacturer.
- .9 The Owner shall provide all natural gas required for field testing purposes and the Manufacturer is to supply all natural gas for factory and factory witness tests.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for the transfer switch and all accessories showing all internal components, installation requirements and control schematics. Ensure that the shop drawings and product data sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section.
- .2 Manufacturer's Inspection & Certification & Start-Up & Test Reports: Submit a report from the transfer switch manufacturer to confirm that the manufacturer has inspected the completed installation and found it acceptable, and a report documenting that he has supervised successful start-up and adjustment of the equipment, all as specified in Part 3 of this Section.
- .3 Submit complete Shop Drawings for approval, Operation and Maintenance Training Material: When on-site maintenance and training is complete, supply and hand to the Owner the documents outlining complete operation and maintenance procedures.

1.2 QUALITY ASSURANCE

- .1 The transfer switch is to be in accordance with requirements of the following, as applicable:
 - .1 UL 1008, Standard for Safety Transfer Switch Equipment, latest edition.
 - .2 CSA C22.2 No. 178, Automatic Transfer Switches
 - .3 CSA C282, Emergency Electrical Power Supply for Buildings, latest edition.
 - .4 CSA C22.2 No 178.1-Requirements for Transfer Switches, latest edition.
 - .5 IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications, latest edition.

1.3 ON-SITE TRAINING

- .1 The transfer switch manufacturer/supplier is to provide the required on-site training session for members of the Owner's designated personnel on transfer switch operation and maintenance procedures up to four hours if needed.

1.4 ON-SITE ONE YEAR SERVICE AND MAINTENANCE

- .1 Include for supplying a transfer switch supplier's qualified service representative for the following on-site transfer switch service and maintenance for one year following Substantial Performance of the work:
 - .1 twenty-four hour, seven day a week emergency repair service with a maximum two hour response time
 - .2 all required service and maintenance in accordance with requirements of the O & M Manual
 - .3 at the end of the one year period, a complete inspection and test
- .2 Notify the Owner forty-eight hours in advance of each site visit for service and maintenance procedures. One or more Owner's personnel will accompany the service representative during each visit to gain further knowledge re: service and maintenance procedures.

2 PRODUCTS

2.1 MECHANICALLY HELD LOAD TRANSFER SWITCH

- .1 Open Transition Type
 - .1 The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators that include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

- .2 All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
- .3 The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
- .4 All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
- .5 Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
- .6 Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources is not acceptable.
- .7 Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated CU pressure connectors shall be provided.
- .2 Microprocessor Controller
 - .1 The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
 - .2 A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.2\%$. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C (-4 to +140 degrees F) and storage from -55 to +85 degrees C (-67 to +185 degrees F).
 - .3 The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.
 - .4 All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
 - .5 The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - .1 IEEE472 (ANSI C37.90A) Ring Wave Test.
 - .2 EN55011 1991 Class A Conducted and Radiated Emission.
 - .3 EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge.
 - .4 EN61000-4-3 Radiated Electromagnetic Field Immunity.
 - .5 EN61000-4-4 Electrical Fast Transient Immunity.
 - .6 EN61000-4-5 Surge Immunity.
 - .7 ENV50141 HF Conducted Disturbances Immunity.
- .3 Enclosure
 - .1 The ATS/BPS shall be furnished in an EEMAC type 1 enclosure unless otherwise shown on the plans.
 - .2 All standard and optional door-mounted switches and pilot lights shall be 16-mm (5/8") industrial grade type or equivalent for easy viewing and replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.
- .4 Controller Display and Keypad
 - .1 A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
 - .1 Nominal line voltage and frequency

- .2 Single or three phase sensing
- .3 Operating parameter protection
- .4 Transfer operating mode configuration
(Open transition, Closed transition or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

.5 Voltage, Frequency and Phase Rotation Sensing

- .1 Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout / Trip	Pickup / Reset
Undervoltage	N&E,3ø	70 to 98%	85 to 100%
Overvoltage	N&E,3ø	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

- .2 Repetitive accuracy of all settings shall be within $\pm 0.5\%$ over an operating temperature range of -20°C to 60°C (-4°F to 140°F).
- .3 Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- .4 The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- .5 Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

.6 Time Delays

- .1 An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
- .2 A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
- .3 Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
- .4 A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- .5 A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes: Acc 31Z
 - .1 Prior to transfer only.
 - .2 Prior to and after transfer.
 - .3 Normal to emergency only.
 - .4 Emergency to normal only.
 - .5 Normal to emergency and emergency to normal.
 - .6 All transfer conditions or only when both sources are available.
 - .7 All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
 - .8 All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

.6 Additional Features

- .1 A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

- .2 A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
- .3 Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
- .4 LED indicating lights (16 mm (5/8") industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- .5 LED indicating lights (16 mm (5/8") industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:
- .6 Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
- .7 Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
- .8 An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.
- .9 The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
- .10 Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
 - .1 Enable or disable the routine.
 - .2 Enable or disable transfer of the load during routine.
 - .3 Set the start time.
 - .1 time of day
 - .2 day of week
 - .3 week of month (1st, 2nd, 3rd, 4th, alternate or every)
 - .4 Set the duration of the run.

At the end of the specified duration, the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- .11 System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,
Normal Failed
Load on Normal
TD Normal to Emergency
2min15s
Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

- .12 Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller, which may be preventing load transfer commands from being completed.
- .13 Double Pole Double Throw contacts shall be provided to indicate voltage present at the Normal and Emergency source transfer switch terminals.
- .14 Selective load disconnect contacts with double pole double throw contacts with adjustable times delays to operate pre and post transfer.
- .15 Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
 - .1 Event Logging
 - .1 Date and time and reason for transfer normal to emergency.
 - .2 Date and time and reason for transfer emergency to normal.
 - .3 Date and time and reason for engine start.
 - .4 Date and time engine stopped.
 - .5 Date and time emergency source available.
 - .6 Date and time emergency source not available.
 - .2 Statistical Data
 - .1 Total number of transfers.
 - .2 Total number of transfers due to source failure.
 - .3 Total number of day's controller is energized.
 - .4 Total numbers of hours both normal and emergency sources are available.
- .16 Communications Module - The communications shall be capable of connecting to the Ethernet TCP/IP network with standard 10base T(RJ-45) connector. This module shall allow for the seamless integration of existing or new communication transfer devices.
- .7 Withstand and Closing Ratings
 - .1 The ATS/BPS shall be rated 200 kA to close on and withstand the available RMS symmetrical short circuit current at the ATS/BPS terminals with the type of overcurrent protection shown on the plans.
 - .2 The ATS/BPS shall be CSA listed in accordance with CSA C22.2 N0. 178 and be labeled in accordance with that standard's ratings. ATS/BPS which are not tested and labeled in accordance with that standard's section 7, are not acceptable.

WITHSTAND CURRENT RATINGS when used with MOLDED-CASE CIRCUIT BREAKERS

Switch Rating (Amps)	WCR	Available Symmetrical Amperes RMS at 600 Volts AC Max. Fuse Size (Amps)
30	100,000	50
70	200,000	150
100	200,000	150
150	200,000	225
260	200,000	600
400	200,000	600
600	200,000	2000
800	200,000	2000
1000	200,000	2500
1200	200,000	2500

1600	200,000	2500
2000	200,000	2500

.8 Tests and Certification

- .1 The complete ATS/BPS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- .2 Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- .3 The ATS/BPS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

.9 Service Representation

- .1 The ATS/BPS manufacturer shall maintain a national service organization of company-employed personnel located throughout Canada. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
- .2 the manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

3 EXECUTION

3.1 INSTALLATION OF TRANSFER SWITCH

- .1 Provide an emergency power transfer switch where shown. Unless otherwise indicated, secure the switch enclosure in place, level and plumb, on a concrete housekeeping pad. Ensure adequate clearance for access and maintenance as per Code requirements.
- .2 Provide housekeeping pad and extend 4 inches beyond enclosure.
- .3 Do all required power and control connections in accordance with certified power and control wiring schematics and the switch manufacturer's instructions.
- .4 Carefully coordinate any building automation system connections to the control panel with the trade performing the building automation system work.

3.2 SITE TESTING, START-UP, AND CERTIFICATION

- .1 When installation of the transfer switch is complete and initial inspections by the supplier's representative have been completed, obtain from the supplier's representative and forward to the Consultant a letter to confirm site inspection and proper installation of the equipment.
- .2 Arrange and pay for the set supplier's representative to supervise start-up of the equipment. and prepare and submit signed start-up reports.
- .3 In addition to testing and verification requirements specified in the Sections entitled Electrical Work Commissioning and Electrical Work Testing, perform testing work as specified herein. Notify the Owner and Consultant ten working days in advance of the site testing, and arrange and pay for the switch supplier's representative and a journeyman electrician to be on-site to conduct the tests. Prepare and submit signed reports to confirm successful testing results. Site tests are to include all functions and features of the transfer switch.

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 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 driver 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 drivers for luminaires connected to dimmers are to be suitable in all respects for the application.

2.2 LAMPS

- .1 Light Emitting Diodes (LED's): Current technology LED's with colour temperature of 4000K, unless otherwise noted, a minimum CRI of 80, a rated life of from 50,000 to 70,000 hours based on 70% lumen depreciation level, and heat sinks to remove heat from the bottom of the semiconductors. Acceptable manufacturers are Philips Color Kinetics, OSRAM Opto Semiconductors, Cree Inc., Nitchia Corp., and Philips Lumileds Lighting Co.

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 luminaire 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 (1/4") 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 LUMINAIRE CIRCUIT WIRING

- .1 Connect luminaires to circuits indicated with wiring as specified.

3.5 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 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 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 LAMPS

- .1 Light emitting diodes (LED's): Current technology LED's with a colour temperature of 4000K a minimum CRI of 80, a rated life of from 50,000 to 70,000 hours based on 70% lumen depreciation level, and heat sinks to remove heat from the bottom of the semiconductors. Acceptable manufacturers are Philips colour Kinetics, OSRAM Opto Semiconductors, Cree Inc., Nichia Corp., and Philips Lumileds Lighting Co.
- .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 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.

3.2 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 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.

3.5 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 – REMOTE-POWERED

- .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 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 Twin 6V-4W LED Remote Head
- .9 10-year warranty
- .10 Acceptable manufacturers are:
 - .1 Canlyte Inc. "Uniglo"
 - .2 Lumacell Inc.
 - .3 Emergi-Lite Ltd.
 - .4 Hubbell Inc. "Dual-Lite"
 - .5 Luxnet Corp.
 - .6 Beluce Canada
 - .7 Philips "Lightguard"
 - .8 Stanpro

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 SUMMARY

- .1 Section Includes:
 - .1 Digital Occupancy and Daylighting Sensor Control
- .2 Related Section
 - .1 Refer to Division 26 for lighting fixtures and wiring details.

1.2 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
- .2 Underwriter Laboratories of Canada (ULC)
- .3 International Electrotechnical Commission
- .4 International Organization for Standardization (ISO)
- .5 National Electrical Manufacturers Association (NEMA)
- .6 WD1 (R2005) - General Color Requirements for Wiring Devices.
- .7 Underwriters Laboratories, Inc. (UL)
 - .1 916 - Energy Management Equipment.

1.3 SYSTEM DESCRIPTION AND OPERATION

- .1 The Lighting Control System as defined under this section covers the following equipment:
 - .1 Digital Room Controllers - Self-configuring, digitally addressable one, two or three relays controllers with 0-10 volt control for drivers (if applicable) and single relay application-specific plug load controllers.
 - .2 Digital Occupancy Sensors - Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 - .3 Digital Switches - Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
 - .4 Digital tunable white controllers. 0-10 Volt controller similar to dimmer and designed to interface with colour tuning driver inputs. Provide separate control wiring.
 - .5 Digital touch screen. Touch activated user interface device with custom programmable graphics for each specific location.
 - .6 Low voltage lighting dimmer panel as indicated.

1.4 LIGHTING CONTROL APPLICATIONS

- .1 Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:
 - .1 Space Control Requirements - Provide occupancy/vacancy sensors with Manual-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
 - .2 Bi-Level Lighting - Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used.
 - .3 Provide occupancy/vacancy sensors for any enclosed office, conference room, meeting room, and training room. For spaces with multiple occupants or where line-of-sight may be obscured, provide ceiling- or corner-mounted with manual-on switches.
 - .4 Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four (4) pre-set lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to extinguish all lighting in the space.
- .2 Refer to lighting sequence of operation within drawing package.

1.5 SUBMITTALS

- .1 Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- .2 Shop Drawings:
 - .1 Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
 - .2 Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.
- .3 Product Data: Catalog sheets, specifications and installation instructions.
- .4 Include data for each device which:
 - .1 Indicates where sensor is proposed to be installed.
 - .2 Prove that the sensor is suitable for the proposed application.

1.6 QUALITY ASSURANCE

- .1 Manufacturer: Minimum 10 years experience in manufacture of lighting controls.

1.7 PROJECT CONDITIONS

- .1 Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 - .1 Ambient temperature: 0° to 40° C (32° to 104° F).
 - .2 Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

- .1 Provide one year complete manufacturer's warranty on all products to be free of manufacturers' defects.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Acceptable Manufacturer:
 - .1 WattStopper around whose products this specification is written or
 - .2 N-Light
 - .3 Cooper Lighting control Wave link (Wired)
 - .4 Lutron
- .2 Substitutions:
 - .1 All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the Consultant a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
 - .2 By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted in an alternate color to the Consultant for review and approval prior to rough-in.

2.2 SINGLE/DUAL RELAY WALL SWITCH OCCUPANCY SENSORS

- .1 Type UW: Manual-ON, Automatic-OFF ultrasonic wall switch occupancy sensor with Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper UW-100, UW-200.

2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- .1 Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.
- .2 Units shall not have any dip switches or potentiometers for field settings.
- .3 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- .4 WattStopper product numbers: LMDX

2.4 DIGITAL WALL SWITCHES

- .1 Low voltage momentary pushbutton switches in 1, 2, 3, 4 configuration; available in white; compatible with wall plates with decorator opening. Wall switches shall include the following features:
 - .1 Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 - .2 Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 - .3 Red configuration LED on each switch that blinks to indicate data transmission.
 - .4 Blue Load/Scene Status LED on each switch button with the following characteristics:
 - .1 Bi-level LED
 - .2 Dim locator level indicates power to switch
 - .3 Bright status level indicates that load or scene is active
 - .5 Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
- .2 The following switch attributes may be changed or selected using a wireless configuration tool:
 - .1 Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 - .2 Individual button function may be configured to Toggle, On only or Off only.
 - .3 Individual scenes may be locked to prevent unauthorized change.
 - .4 Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 - .5 Ramp rate may be adjusted for each dimmer switch.
 - .6 Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
- .3 WattStopper product numbers: LMDW-102, LMSW-105, LMDM-101.

2.5 ROOM CONTROLLERS

- .1 Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
 - .1 Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 - .2 Simple replacement - Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
 - .3 Device Status LEDs to indicate:
 - .1 Data transmission
 - .2 Device has power
 - .3 Status for each load
 - .4 Configuration status
 - .4 Quick installation features including:
 - .1 Standard junction box mounting
 - .2 Quick low voltage connections using standard RJ-45 patch cable
 - .5 Plenum rated
 - .6 Manual override and LED indication for each load
 - .7 Dual voltage (120/277 VAC, 60 Hz)
 - .8 Zero cross circuitry for each load.

- .2 On/Off Room Controllers shall include:
 - .1 One or two relay configuration
 - .2 Efficient 150 mA switching power supply
 - .3 Three RJ-45 DLM local network ports
 - .4 Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
 - .1 One relay configuration only
 - .2 Automatic-ON/OFF configuration
 - .5 WattStopper product numbers: LMRC-101, LMRC-102
- .3 On/Off/Dimming enhanced Room Controllers shall include:
 - .1 Real time current monitoring
 - .2 One, two or three relay configuration
 - .3 Efficient 250 mA switching power supply
 - .4 Four RJ-45 DLM local network ports.
 - .5 One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
 - .6 Optional Network Bridge for BACnet MS/TP communications (LMRC-3xx).
 - .7 The following dimming attributes may be changed or selected using a wireless configuration tool:
 - .1 Establish preset level for each load from 0-100%
 - .2 Set high and low trim for each load
 - .3 Set lamp burn in time for each load up to 100 hours
 - .8 Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
 - .1 One relay configuration only
 - .2 Automatic-ON/OFF configuration
 - .9 WattStopper product numbers: LMRC-211, LRMC-212

2.6 OCCUPANCY SENSOR SWITCHES

- .1 Combination passive infrared and ultrasonic sensor/switch assemblies with a rating to suit the connected load, wall (180° coverage) and/or ceiling mounted (360° coverage) as indicated on the drawings, white colour, each complete with time, range and light adjustments, adjustable blinders to block peripheral signals, a photocell to detect light to enable ambient light override, Fresnel lens, LED indicator which flashes when the sensor detects motion, and a manual on-off push button. Wattstopper product number: DT-355.

3 EXECUTION

3.1 INSTALLATION

- .1 Work by Division 26:
 - .1 Lighting fixtures and wiring to be supplied, wired, installed and tested, by Division 26.
 - .2 Division 26 to install room controllers above room door/switches (as per engineer or drawings). All room controllers to be accessible for maintenance/repair. All high voltage wiring is to be completed by this division. Division 26 to wire high voltage side to room controllers including emergency light controllers and plug load controllers. Division 26 to ensure proper wiring of circuits by using test button on the controllers.
 - .3 All room controllers including emergency and plug load controllers to be mounted in accessible areas for maintenance/repair. Division 26 to provide appropriate enclosure/panel for all controllers including plug load controllers.
- .2 Work by Lighting controls integrator (carried under Division 26):
 - .1 All digital lighting system (DLM) components including emergency lighting controller are to be provided by Division 26. DLM components include: switches, occupancy sensors, room controllers, emergency light controllers,
 - .2 Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
 - .3 Provide written or computer-generated documentation on the commissioning of the system

including room by room description including:

- .1 Sensor parameters, time delays, sensitivities, and daylighting setpoints.
- .2 Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
- .3 Load Parameters (e.g. blink warning, etc.)
- .4 Re-commissioning - After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

3.2 COMMISSIONING

- .1 Upon completion of the installation, the system shall be commissioned by the authorized representative or by a system partner integrator (Lighting controls integrator.) who will verify a complete fully functional system.
- .2 The contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system start-up and adjustment date.
- .3 Upon completion of the system commissioning the control contractor shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS FOR REVIEW

- .1 The Cabling Contractor (hereafter referred to as CC) shall submit as part of the evaluation package the following:
 - .1 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 & optical fibre 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 An optical loss budget calculations for each optical fibre run.
 - .3 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 - Provide catalogue cut sheets and information for the following:
 - .1 Wire, cable, and optical fibre
 - .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
- .2 The CC shall submit at the conclusion of the project or project phase the following:
 - .1 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 Server Room (ESR 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 Optical fibre power metre/light source test results.

1.2 QUALITY ASSURANCE

- .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-568-B.3 -- Optical Fibre Cabling Components Standard
 - .4 ANSI/TIA/EIA-569-A -- Commercial Building Standard for Telecommunications Pathways and Spaces
 - .5 ANSI/TIA/EIA-606(A) -- The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - .6 ANSI/TIA/EIA-607(A) -- Commercial Building Grounding and Bonding Requirements for Telecommunications
 - .7 ANSI/TIA/EIA-526-7 -- Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 - .8 ANSI/TIA/EIA-526-14A -- Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant
 - .9 ANSI/TIA/EIA-758(A) -- Customer-Owned Outside Plant Telecommunications Cabling Standard
- .2 Install cabling in accordance with the most recent edition of BICSI® publications:
 - .1 BICSI -- Telecommunications Distribution Methods Manual
 - .2 BICSI -- Cabling Installation Manual
 - .3 BICSI -- LAN Design Manual
 - .4 BICSI - Customer-Owned Outside Plant Design Manual
- .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 Provide Belden IBDN (hereafter referred to as Nordx) cabling systems. Provide Promaxis Precision Metal relay racks or equivalent approved.
 - .1 The contractor shall be an authorized Nordx CSV (Certified System Vendor).
 - .2 The contractor shall have worked satisfactorily for a minimum of five (5) years on systems of this type and size.
 - .3 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.
 - .4 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.

- .5 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.
- .6 Subcontractors shall assume all rights and obligations toward the contractor that the contractor assumes toward the owner and engineer/designer.

1.3 SUMMARY

- .1 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.
 - .1 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 Optical fibre installation, including patch panels
 - .5 Telecommunications outlets
 - .6 Terminal blocks/cross-connect systems
 - .7 Equipment racks and cabinets
 - .8 System testing, and
 - .9 Documentation and submissions
 - .2 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.
 - .3 Provide complete and operational system components and wiring.
 - .4 Equipment (switches) and rack mounted UPS units by the Owner
 - .5 Antena system to connect building communication system with the Owner's communication system. The Contractor to provide 50 m conduit from level 2 communication room to location of antenna on the roof for wiring by antenna provider. Contractor provides power as per antenna requirements.

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 and data services throughout Nephrology building as indicated on the drawings. The cabling system shall be standards compliant and composed of the following interdependent sub-systems:
 - .1 (MC) Main Cross-connect System
 - .2 (IC) Intermediate Cross-connect System
 - .3 (WA) Work Area (outlet, jacks, associated cords and adapters)
 - .4 (HC) Horizontal Cross-connect System (HC)
 - .5 (A,B,C) Backbone Cable
 - .6 () Horizontal
- .2 Cabling sub-system distances must conform to the limitations listed in the following table:
Telecommunications Cabling System Distance Limitations.

	A	B	C	D
UTP Copper (Voice Cables)	2,624ft (800)	1,640ft (500)	984ft (300)	295ft
TYP Copper (Data Cables)	296ft (*90)	296ft (*90)	296ft (*90)	295ft
Multimode Fibre	6,560ft (2000)	1,640ft (500)	4,820ft (1500)	295ft
Singlemode Fibre	9,840ft (3000)	1,640ft (500)	8,200ft (2,500)	295ft

- .3 The Horizontal Cable Plant Infrastructure shall be supplied and installed as per the following logical drawing:

	PRODUCT	DESCRIPTION
A	Equipment Cord	PATCH CABLE CAT6 SOLID 4-PAIR UTP RJ45-OPEN
B	IDC CONNECTING BLOCK	CAT6 25-PAIR CONNECTING BLOCK, 4 PAIR MARKING (BIX)
C	Cross-Connect	CAT6 4-PAIR UTP CROSS-CONNECT WIRE
D	IDC CONNECTING BLOCK	CAT6 25-PAIR CONNECTING BLOCK, 4 PAIR MARKING (BIX)
E	Cable Support Hardware	CONTRACTOR SUPPLIED CONDUIT AND CABLE TRAY
F	Horizontal Cable	CABLE CAT6 4-PAIR UTP CMP
G	Work Area Outlet	JACK CAT6 MODULAR
H	Equipment Cord	PATCH CABLE CAT6 4-PAIR UTP RJ45-RJ45

This infrastructure can be described as follows;

At 'A' the RJ45 plug shall be connected directly to the rack mounted network equipment (switch). The equipment cord shall be routed from the equipment rack to a wall mounted IDC field and terminated to 'B'.

Within the Telecommunications Room 'B', 'C' and 'D' represent the wall mounted IDC field. The contractor shall supply a backboard for the installation of this field. The IDC field shall be laid out as per the manufacturer recommendations and the Client Technical Authority.

At 'H', the patch cable is connected from the jack at 'G' to the device accessing the network (PC, printer, etc.).

Although 'B', Part 2 - Products' of this document and the engineering drawings for site specific work may differentiate between systems (Voice and Data) at the work area outlet, it is the intent to install a systems generic horizontal cable channel ('D', 'F' and 'G' above). Systems allocation and activation will be done through cross-connect patching ('C' above).

The typical IDC field shall be installed on a wall mounted backboard as follows;

The vertical rows of the IDC mounts in the Equipment Cable Field will be allocated to function as determined by the Client Technical Authority.

Equipment Cable fields will consist of Voice and Data systems.

- .1 A telecommunications cabling infrastructure generally consists of one telecommunications outlet in each workstation (WA), wall telephones in common and mechanical areas, Telecommunications Server Rooms (TRs) located on each floor or one for each floor area of 21,530 ft² (2000 m²), the Equipment Room (ER), and the building Rate Demarcation Point (RDP).
- .2 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.
- .3 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 wall IDC field located in the appropriate TR.
- .4 Vertical/horizontal copper backbone cabling consists of multiple pair unshielded twisted-pair installed from the main cross-connect (MC) to the horizontal cross-connect (HC) and/or from the MC to the intermediate cross-connect (IC) to the HC. Copper backbone infrastructures are to be utilized to provide voice telecommunications services.
- .5 Vertical/horizontal backbone cabling consists of OS2 single mode optical fibre 12-strand cabling as per the Client Technical Authority installed from the MC to the HC and/or from the MC to the IC to the HC. Fibre optic backbone infrastructures are to be utilized to provide data communications services. Refer to single line diagram on drawings.

1.6 CABLING CONTRACTORS

- .1 The following Cabling Contractors shall be carried by the Contractor:
 - .1 Bell
 - .2 FCI

- .3 Marcomm
- .4 Volmer
- .5 Fiber Core
- .6 Leviton

1.7 WARRANTY

- .1 Upon completion of the project the CC shall provide to the Client Technical Authority a 25 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 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 15 working 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.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 All horizontal cabling cable components required to provide a telecommunications channel shall be manufactured by Nordx.
- .2 All backbone cabling cable components required to provide a telecommunications channel shall be manufactured by Nordx.
- .3 Where no manufacturer is specified, provide products of manufacturers in compliance with contract requirements

2.2 SUITABILITY

- .1 Provide products that are suitable for intended use, including, but not limited to environmental, regulatory, and electrical.

2.3 VOICE/DATA TELECOMMUNICATIONS SERVICE BACKBONE CABLE

- .1 Solid copper, 24 AWG, 100 (Ohm) balanced twisted-pair (UTP) backbone cable, in sizes as indicated on the drawings, with mechanical and transmission performance specifications that meet or exceed the Category 6 standard ANSI/TIA/EIA-568-B.2-1
Note: Listed Type CMR, CMP, MPR and/or MPP (as required by code).
- .2 OS2 single mode optical fibre 12-strand cabling, as specified by the Client Technical Authority, with

mechanical and transmission performance specifications that meet or exceed ANSI/TIA/EIA-568-B.3

2.4 VOICE TELECOMMUNICATIONS HORIZONTAL STATION CABLE

- .1 Solid copper, 24 AWG, 100 (Ohm) balanced twisted-pair (UTP) Category 6 cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-B.2-1 up to 250 MHz.
Note: Listed Type CMP (as required by code).
Voice cable to be white in colour, Belden Cable - 2413 Series #24567315.

2.5 DATA TELECOMMUNICATIONS HORIZONTAL STATION CABLE (COPPER)

- .1 Solid copper, 24 AWG, 100 (Ohm) balanced twisted-pair (UTP) Category 6 cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-B.2-1 up to 250 MHz.
Note: Listed Type CMP (as required by code).
Data cable to be blue in colour, Belden Cable - 2413 Series #24567315.

2.6 VOICE/DATA - COPPER & OPTICAL FIBRE WORK AREA JACKS

- .1 Single-gang mounting faceplate or modular furniture faceplate with four (4) openings containing the following devices:
Nordx P/N: AX101437 - colour to match wall or AX1003xx - colour to match modular furniture.
- .2 Voice Jack - 8-pin modular, category 6, unkeyed, red, pinned to T568 (A) standards.
Nordx P/N: AX101067
- .3 Data Jack - 8-pin modular, category 6, unkeyed, red, pinned to T568 (A) standards.
Nordx P/N: AX101068
- .4 Optical Fibre Connectors -SC fibre module (or as directed by the Client Technical Authority).
Nordx P/N: A040700x - colour to match faceplate colour.

2.7 WALL VOICE OUTLETS

- .1 Single-gang stainless steel faceplate with six-conductor jack and wall telephone mounting lugs
Nordx P/N: AX102005 with AX101321 keystone modular jack

2.8 IDC TERMINATION BLOCKS

- .1 Provide a Nordx GigaBIX Cross-Connect System. All MC, IC and HC system terminations are to be made to the appropriate GigaBIX Distribution Connector.
- .2 GigaBIX fields to be laid out as per the Client Technical Authority and Nordx design and layout recommendations. Refer to 'A Part 1 - General, Section 4 - System Description' for typical layout.
- .3 All cabling and mounting components used to be manufactured by Nordx.
Typical GigaBIX components used are;
GigaBIX Mount Nordx P/N: AX101472
GigaBIX D-Ring Nordx P/N: AX101478
GigaBIX Connector Nordx P/N: AX101447 (6 port) and AX101448 (25 pair)

2.9 TELECOMMUNICATIONS ROOM COPPER PATCH CORDS

- .1 All patch cords used to provide an interface between the active equipment and the IDC field to be 3.0m manufactured by Nordx. They shall be GigaFlex PS6+ Category 6 Modular Cords, gray, solid, RJ45/open.
Nordx P/N: AX3501xx

2.10 WORK AREA COPPER PATCH CORDS

- .1 All patch cords used to provide data service to be manufactured by Nordx. They shall be GigaFlex PS6+ Category 6 Modular Cords, solid, RJ45/RJ45.
Nordx P/N: AX3800xx. Provide the following quantities - 200 1.2m; 200 2.1m; 200 3.0m.

2.11 RACK MOUNTED OPTICAL FIBRE TERMINATION PANELS

- .1 19 in. rack-mounted black optical fibre termination panel, sized and outfitted as per the Client Technical Authority and/or the project drawings. Panel is to be sized to provide 100% growth. Nordx P/N: AX100068.

2.12 OPTICAL FIBRE ADAPTER STRIPS

- .1 Double density pre-loaded singlemode 12 LC duplex adapter strips
Nordx P/N: AX101743

2.13 SPLICE TRAYS

- .1 Manufactured by Nordx and sized for OS2 single mode optical fibres 12-strand cabling, nonmetallic with clear plastic cover, 12-fibre splice capacity, compatible with splice enclosure and splicing method.

2.14 OPTICAL FIBRE CONNECTORS

- .1 Ceramic tipped field installed singlemode LC connectors, which meet or exceed the performance specifications in ANSI/TIA/EIA-568-B.3.
Nordx P/N: AX101983

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 Provide a 12" (305 mm) long copper ground bar in each Data Room and connect to nearest main electrical room ground bus with #6 green ground.
- .4 Connect cabinets, racks, and frames to single-point ground refer to item 3.1.3 above, 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:
 - .1 Label each outlet with permanent self-adhesive label with minimum 3/16 in. high characters.
 - .2 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.
 - .3 Use colour-coded labels for each termination field that conforms to ANSI/TIA/EIA-606(A) standard colour codes for termination blocks.
 - .4 Mount termination blocks on colour-coded backboards.
 - .5 Labels shall be machine-printed. Hand-lettered labels shall not be acceptable.
 - .6 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).
 - .7 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 TERMINATE

- .1 Terminate data cables on data racks; terminate voice cables on Bix blocks.

3.4 TESTING

- .1 Testing shall conform to ANSI/TIA/EIA-568-B.1 standard. Testing shall be accomplished using level II 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.
 - .1 Perform testing of copper cables with tester meeting ANSI/TIA/EIA-568-B.1 requirements.
 - .2 If copper backbone cable contains more than one (1) percent bad pairs, remove and replace entire cable.
 - .3 If horizontal cable contains bad conductors or shield, remove and replace cable.
- .3 Test optical cable with a light source and power metre utilizing procedures as stated in ANSI/TIA/EIA-526-14A: OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fibre Cable Plant and ANSI/TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Singlemode Fibre Cable Plant. Measured results shall be plus/minus 1 dB of submitted loss budget calculations. If loss figures are outside this range, test cable with optical time domain reflectometer to determine cause of variation. Correct improper splices and replace damaged cables at no charge to the owner.
 - .1 Cables shall be tested at 850 and 1300 μ m for multimode optical fibre cables. Cables shall be tested at 1310 and 1550 μ m for singlemode optical fibres.
 - .2 Testing procedures shall utilize "Method B" - One jumper reference.
 - .3 Bi-directional testing of optical fibres is required.
- .4 Where any portion of system does not meet the specifications, correct deviation and repeat applicable testing at no additional cost to the owner.
- .5 Provide written report of all testing to the Consultant and to the Commissioning Agent for review.

3.5 PLYWOOD BACKBOARDS

- .1 Line all walls of I.T. Rooms with fire retardant painted plywood backboards floor to ceiling.

3.6 CONDUIT

- .1 All wiring in conduit and cable tray.
- .2 Electrical Metallic Tubing (EMT) of the sizes indicated shall be installed.
- .3 Conduit extending from outlet to cabletray/raceway shall be a minimum of 1" (25 mm) unless the cable exceed a 40% fill ratio.
- .4 No EMT shall be smaller than 1" (25 mm) unless specifically detailed in this document.
- .5 No more than two - 90° bends in conduit between pull points. Provide a pull box for every 100' (30 m) of conduit. Pull boxes are not to be used as bends.
- .6 Conduits of 2" (50 mm) or less to have a bend radius of six (6) times the conduit diameter. a conduit greater than 2" (50 mm) to have a bend radius of ten (10) times the conduit diameter.
- .7 Bush, ream and remove any sharp projections on all conduits.
- .8 All conduit shall be labelled at each end indicating the destination.
- .9 Run all conduit parallel or perpendicular to building grid lines.
- .10 Slots and sleeves to extend a minimum of 2" (50 mm) above the finished floor. Conduits shall protrude a minimum of 3" (76 mm) into rooms through walls to cable tray.
- .11 Refer to drawings for additional conduit requirements.

3.7 COVERPLATES

- .1 Provide stainless steel coverplates for all flush mounted outlets in service rooms; and provide ivory colour nylon coverplates for all flush mounted outlets in the remainder of the building.

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 Control switches, two for each type used
 - .5 Indicating lamps, five for each type and colour used
 - .6 Provide 5 extra bells and 5 extra strobes for installation after sound tests are conducted
 - .7 Fuses, three for each type used
 - .8 End-of-line resistors, five
 - .9 Isolators, five
- .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
 - .22 CAN/ULC-S1001, Integrated Systems Testing of Fire Protection and Life Safety Systems
- .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.
- .4 Include for a one year no cost (to the Owner) maintenance period to commence at notification of

Substantial Performance and which is to include two site inspections of the system with reports. Inspections are to be scheduled with the Owner and Consultant.

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.
- .4 Where the work is phased and completed phases will be accepted and occupied by the Owner, include for requirements of paragraphs .1 to .3 above for each such phase.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with requirements specified in the Section entitled Basic Electrical Materials and Requirements.

1.6 ACCEPTABLE MANUFACTURERS

- .1 Edwards cat #EST4 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. – Mircom

1.7 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

1.8 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.

1.9 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 60 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 requirements
 - .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 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

1.10 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 A (Style Z) 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 35°C (65°F) or reaches its fixed temperature alarm set point of 57°C (135°F) 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: 0°C to 38°C (32°F to 100°F)
 - .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 57°C (135°F) 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: 0°C to 38°C (32°F to 100°F)
 - .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: 0°C to 49°C (32°F to 120°F)
 - .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 57°C (135°F) or due to a temperature Rate of Rise of 9°C/minute (15°F/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 57°C (135°F). 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 to 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 of 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: 0°C to 49°C (32°F to 120°F)
 - .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 All Manual Fire Alarm station shall be suitable for operation in the following environment:
 - .1 Temperature: 0°C to 49°C (32°F to 120°F)
 - .2 Humidity: 0-93% RH, non-condensing

2.7 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 textured red 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.

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 105°C (220°F) 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 representative 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, and 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 INTEGRATED SYSTEMS TESTING OF FIRE PROTECTION AND LIFE SAFETY SYSTEMS

- .1 Retain and pay for all costs for the services of an independent third-party Life Safety Systems Commissioning Agent to perform testing and commissioning of integrated fire protection and life safety systems in accordance with CAN/ULC-S1001. The Commissioning Agent shall have worked satisfactorily for a minimum of five (5) years on systems of this type and size.
- .2 Submit testing procedures, report samples, sequence of operation and testing plan to consultant 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 Mass Notification Systems
 - .3 Emergency Power Systems (Generators, Transfer Switches, etc.)
 - .4 Audio/Visual And/Or Lighting Control Systems
 - .5 Notification Systems (Directional Evacuation Signage, Fire Do Not Enter Signage, etc.)
 - .6 Sprinkler And/Or Standpipe Systems
 - .7 HVAC Systems (BAS Connections, Prevention of Smoke Circulation, Fire and/or smoke closures, etc)
 - .8 Water Supplies And/Or Water Supply Control Valves
 - .9 Freeze Protection Systems
 - .10 Fixed Fire Suppression Systems
 - .11 Cooking Equipment Fire Suppression Systems
 - .12 Door Hardware (Hold-Open Devices, Electromagnetic Locks, etc.)
 - .13 Smoke Control Systems
 - .14 Emergency Lighting
 - .15 Hazardous Protection Monitoring
- .4 The process shall be coordinated 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 Submit signed testing reports to consultant upon completion.
- .7 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.
- .8 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.
- .9 Include a copy of the testing plan, testing forms, re-testing forms and testing report in O&M manuals.

3.6 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

**SECTION 31 05 16
AGGREGATES FOR EARTHWORK**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete

1.2 ABBREVIATIONS

- .1 GW: Well-graded gravel
- .2 GP: Poorly graded gravel
- .3 GC: Clayey gravel
- .4 SW: Well-graded sand
- .5 SP: Poorly graded sand
- .6 SC: Clayey sand
- .7 CL: Lean clay
- .8 ML: Silt
- .9 CH: Fat clay
- .10 MH: Elastic silt

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .2 ASTM D1140-17, Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No.200) Sieve in Soils by Washing
 - .3 ASTM D2487-17e1, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - .4 ASTM D4318–17e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - .5 ASTM D4791-19, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's instructions, product literature, and data sheets for aggregate materials. Include product characteristics, performance criteria, practical size, finishes, and limitations.
- .3 Samples:
 - .1 Submit 5-kg samples of each type of aggregate, as specified.

- .2 Allow continual sampling by department representative during production.
- .3 Supply new or clean sample bags or containers appropriate for the type of aggregate materials.
- .4 Install sampling facilities at discharge end of production conveyor to allow department representative to obtain representative samples of items being produced. Stop conveyor belt when requested by department representative to permit full cross-section sampling.
- .5 Provide front-end loader or other suitable equipment and a trained operator for stockpile sampling as necessary. Move samples to storage location reviewed by department representative.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Segregation, contamination, and degradation of aggregates during handling and transportation is not permissible.
- .3 Store washed materials or materials excavated from underwater for a minimum of 24 hours to allow for free drainage of water and for materials to reach uniform water content.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Aggregate Quality: Sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, and adherent coatings or other deleterious substances.
- .2 Flat and Elongated Particles of Coarse Aggregate: To ASTM D4791.
 - .1 Length to thickness ratio equal to or greater than 5:1.
- .3 Fine aggregates satisfying requirements of applicable sections, such as Section 03 30 00 - Cast-in-Place Concrete to be one of or a blend of the following:
 - .1 Screenings produced from crushing quarried rock, boulders, gravel or slag.
 - .2 Reclaimed asphalt pavement.
 - .3 Reclaimed concrete material.
- .4 Coarse aggregates satisfying requirements of applicable sections, such as Section 03 30 00 - Cast-in-Place Concrete to be one of or a blend of the following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Lightweight aggregate, including slag and expanded shale.
 - .4 Reclaimed asphalt pavement.
 - .5 Reclaimed concrete material.

2.2 SOURCE QUALITY CONTROL

- .1 Inform department representative of proposed source of aggregates and provide access for sampling a minimum 4 weeks before starting production.
- .2 If materials from proposed source do not meet or cannot reasonably be processed to meet specified requirements then locate alternative source.

- .3 Advise department representative a minimum 4 weeks in advance of proposed change of material source.
- .4 Provide department representative with access to source and processed material for sampling.
- .5 Acceptance of material at source does not exclude it from potential future rejection if it fails to conform to specified requirements, lacks uniformity, or if its site performance is found to be unsatisfactory.
- .6 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions in accordance with Section 01 71 00 - Examination and Preparation.
 - .1 Topsoil:
 - .1 Examine topsoil for clods, rocks, snow, large roots, litter, and toxic substances before proceeding with stripping.
 - .2 Proceed with topsoil stripping, after unacceptable conditions have been remedied.

3.2 PROCESSING

- .1 Process aggregate uniformly using methods that prevent contamination, segregation, and degradation.
- .2 Blend aggregates as required, including reclaimed materials that meet specified requirements in order to satisfy gradation requirements or specified particle shapes.
 - .1 Use methods and equipment reviewed in writing by department representative.
- .3 When operating in stratified deposits use excavation equipment and methods that produce uniform and homogeneous aggregate gradation.
- .4 Screen, crush, wash, classify and process aggregates with suitable equipment to meet requirements.
 - .1 Use only equipment reviewed in writing by department representative.

3.3 STOCKPILING

- .1 Stockpile aggregates on site in locations as indicated in the contract drawings, unless directed otherwise by Departmental Representative and/or the department representative. Do not stockpile on completed pavement surfaces.
- .2 Stockpile aggregates in sufficient quantities to meet project schedules.
- .3 Use stockpile sites that are level, well-drained and have adequate bearing capacity to support the weight of stockpiled materials and handling equipment.
- .4 Except where stockpiled on acceptably stabilized areas:
 - .1 Provide compacted sand base minimum of 300 mm in depth to prevent contamination of aggregate; or,
 - .2 Stockpile aggregates on ground but do not incorporate bottom 300 mm of stockpile into Work.
- .5 Divide different aggregates by strong, full depth bulkheads, or separate each stockpile by a sufficient distance to prevent intermixing.

- .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials in accordance with Section 01 74 19 - Waste Management and Disposal within 48 hours of rejection.
- .7 Stockpile materials in uniform layers a maximum 1.5 m in depth. Complete and level each layer before placing the subsequent layer.
- .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
- .9 Do not cone piles or spill material over edges of piles. Keep the completed stockpiles neat, regular in form and occupying the smallest possible area.
- .10 Do not use stacking conveyors.
- .11 During winter operations, prevent penetration of ice and snow into stockpile or in material being removed from stockpile.

3.4 CLEANING

- .1 Cleaning: Perform in accordance with Section 01 74 00 - Cleaning.
- .2 Leave aggregate stockpile site in tidy, well-drained condition, free of standing surface water.
- .3 Leave any unused aggregates in neat compact stockpiles in locations directed by Departmental Representative.
- .4 Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.
- .5 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of AHJ.
- .6 Restrict public access to temporary or permanently abandoned stockpiles in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

END OF SECTION

**SECTION 31 11 00
CLEARING AND GRUBBING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 DEFINITIONS

- .1 Clearing: Removal of trees, brush, and other vegetation from a designated area. Clearing is the first step in preparing land for construction or development.
- .2 Grubbing: Removal of roots, stumps, and other underground vegetation remnants after the initial clearing. Grubbing is essential for preparing the soil for further development or excavation.

1.3 REFERENCE STANDARDS

- .1 Canadian Food Inspection Agency (CFIA):
 - .1 S.C. 1997, c. 6, Canadian Food Inspection Agency Act
- .2 Environment and Climate Change Canada (ECCC):
 - .1 S.C. 1999, c. 33, Canadian Environmental Protection Act, 1999
 - .2 S.C. 2019, c. 28, s. 1, Impact Assessment Act, 2019
- .3 Health Canada (HC):
 - .1 S.C. 2022, c. 28, Pest Control Products Act
- .4 Transport Canada (TC):
 - .1 S.C. 1992, c. 34, Transportation of Dangerous Goods Act, 1992

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate work of this section with submittal requirements in Section 01 35 29 - Health, Safety, and Emergency Response Procedures for a site-specific health and safety plan (HSP).
 - .2 Coordinate work of this section with submittal requirements in Section 01 35 43 - Environmental Procedures for a site-specific environmental protection plan (EPP).
- .2 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the department representative and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .1 Identify, flag, or otherwise mark, items designated to remain or to be salvaged.
 - .2 Review delivery, storage, and handling requirements.

- .1 Special requirements for infested materials.
- .3 Review existing surface conditions.
- .4 Identify the unintended potential environmental impact on existing site conditions.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Site-specific pest management plan (PMP) in compliance with Canada Pest Control Products Act, provincial, and municipal regulations.

1.6 QUALITY ASSURANCE

- .1 Comply with the requirements of Section 01 43 00 - Quality Assurance.
- .2 Regulatory requirements:
 - .1 Comply with Canadian Environmental Protection Act, Canadian Food Inspections Agency Act, Impact Assessment Act, Transportation of Dangerous Goods Act, and applicable provincial, and municipal regulations.

1.7 SITE CONDITIONS

- .1 Examine subsurface investigation report as indicated in Section 00 31 00 - Available Project Information.
- .2 Known underground utility lines and buried objects are as indicated on Drawings.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Fill:
 - .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
 - .2 Soil: Free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, or deleterious materials.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation.
 - .2 Verify clearing and grubbing work is coordinated with erosion and sedimentation control measures in Section 01 57 00 - Temporary Controls.

3.2 PREPARATION

- .1 Locate and protect utility lines: Preserve in operating condition active utilities traversing site.
- .2 Notify Departmental Representative immediately of damage to, or when unknown existing utility lines are encountered.
- .3 Notify utility authorities impacted before performing clearing and grubbing work.

3.4 CLEARING

- .1 Clearing: In locations as indicated on the Drawings.

- .1 Cut off trees, stumps, roots, brush, and other vegetation to ground level.
- .2 Tree designated to remain:

3.5 GRUBBING

- .1 Grubbing: In locations as indicated in the Drawings.
- .2 Remove stumps, roots larger than 75 mm in diameter, matted roots, other organic debris, and visible rock fragments to a minimum of 200 mm below ground surface from grubbing areas.
- .3 Remove visible rock fragments and boulders greater than 300 mm in any dimension, but less than 0.25 m³ in accordance with Section 31 23 16.26 - Rock Removal.
 - .1 Notify department representative immediately when unanticipated rock fragments or boulders exceeding these dimensions are encountered.

3.6 FINISHED SURFACE

- .1 Fill depressions resulting from clearing and grubbing] operations with fill material, and compact to make surface uniform with existing adjacent ground surface.
- .2 Leave ground surface in condition ready for immediate grading operations or stripping of topsoil.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Clean and remove debris and sediment from drainage devices in work areas, and dispose of in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Do not clean equipment in waterbodies or where the wash-water can enter waterbodies.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Remove cleared and grubbed materials.
 - .3 Chip or mulch and spread cleared and grubbed vegetative material on site in locations indicated on Drawings.
 - .4 Cut timber greater than 125 mm diameter to 1800 mm lengths and stockpile as indicated on Drawings. Stockpiled timber becomes property of Owner.
 - .5 Diseased trees identified on Drawings: Remove and dispose of in accordance with municipal / provincial regulations.
 - .6 Infested materials:
 - .1 Removal of potentially infested materials from regulated area are to be accompanied by a movement certificate issued by the Canadian Food Inspection Agency (CFIA).
 - .1 Clean vehicles used to transport regulated articles of debris before loading at origin and before departure from the receiving facility.
 - .2 Movement of any ash tree from regulated area without consent of the CFIA is prohibited.

- .1 Ash tree articles include:
 - .1 ash trees (whole or parts);
 - .2 ash nursery stock;
 - .3 ash logs and branches;
 - .4 ash lumber;
 - .5 wood packaging materials with an ash component;
 - .6 ash wood or bark;
 - .7 ash wood chips or bark chips; and,
 - .8 ash firewood.
- .2 Removal of non-ash firewood from regulated area is only permitted by facilities registered under the Emerald Ash Borer Approved Facility Compliance Program (EABAFCP).
- .3 Remove infested materials in accordance with provincial and municipal regulations.

3.8 PROTECTION

- .1 Protect existing fencing, trees, shrubs, landscaping, natural features, benchmarks, buildings, pavement, utility lines, site appurtenances, water courses, and root systems of trees designated to remain.

END OF SECTION

**SECTION 31 14 13
SOIL STRIPPING AND STOCKPILING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 11 00 - Clearing and Grubbing

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 [NOT USED]

- .1 Not used.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation.
 - .1 Verify areas affected by work of this section have been cleared and grubbed in accordance with Section 31 11 00 - Clearing and Grubbing.
 - .2 Verify temporary erosion and sedimentation control measures are installed in accordance with Section 01 57 00 - Temporary Controls.
 - .3 Verify grades are correct.

3.2 STRIPPING OF TOPSOIL

- .1 Conduct topsoil stripping procedures in accordance with applicable provincial and municipal requirements.
 - .1 To avoid compaction of topsoil, remove topsoil before other construction procedures commence.
- .2 Handle topsoil only when it is dry and warm.
- .3 Strip topsoil to full depth as directed by departmental Representative.
 - .1 Avoid mixing topsoil with subsoil. Refer to Section 00 31 00 - Available Project Information for geotechnical report on subsurface soil information.
- .4 Stockpile topsoil in locations as indicated on Drawings.
 - .1 Stockpile height: maximum 3 m.

- .2 Avoid placing stockpile in low areas where natural drainage or storm water could pond or erode these materials during inclement weather.
- .5 Protect stockpiles from adverse weather conditions, contamination, and compaction.
- .6 Cover topsoil that has been piled for 30 days, with sterile plants, such as ray florets, or grass to maintain agricultural potential of soil.

3.3 PREPARATION OF GRADE

- .1 Grade area only when soil is dry to lessen soil compaction.
- .2 Grade soil with scrapers, establishing natural contours to eliminate uneven areas and low spots, and to provide positive drainage.

3.4 SUBSOILING

- .1 Perform subsoiling to designated areas to improve drainage and agricultural potential of soil.
- .2 Work subsoiled area following natural grade contour lines, with vibrating subsoiler to depth of 40 cm.
- .3 Cross subsoiled area following the first pass.
- .4 Cultivate the soil with a chain harrow to break up soil clod.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.
- .3 Dispose of unused topsoil offsite at the Contractors discretion.

END OF SECTION

**SECTION 31 22 13
ROUGH GRADING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 11 00 - Clearing and Grubbing
- .2 Section 31 14 13 - Soil Stripping and Stockpiling
- .3 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .4 Section 32 01 90.33 - Tree and Shrub Preservation

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - .2 ASTM D1557-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

1.3 EXISTING CONDITIONS

- .1 Known underground and surface utility lines and buried objects are indicated on the Drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation.
 - .1 Examine soil for unsuitable conditions such as surface water, clods, rocks, snow, frost, freezing, mud, large roots, litter, potentially toxic substances, and unstable material.
 - .2 Proof roll the subgrade areas indicated on the Drawings and as per the request of the department representative.
 - .2 Verify and coordinate rough grading with:
 - .1 Erosion and sedimentation control measures in Section 01 57 00 - Temporary Controls.
 - .2 Clearing and grubbing, performed in accordance with Section 31 11 00 - Clearing and Grubbing.
 - .3 Topsoil removal, performed in accordance with Section 31 14 13 - Soil Stripping and Stockpiling.
- .3 Verify subgrades are correct and sloped as indicated on the Drawings.

3.2 PREPARATION

- .1 Remove litter and unsatisfactory and unstable materials.
- .2 Stake and flag locations of utilities.
- .3 Protect existing underground and above head utilities.

3.3 GRADING

- .1 Rough grade to levels, profiles, and contours as indicated on the Drawings.
- .2 Rough grade to the following depths below finish grades:
 - .1 Grassed areas: 100 mm or as indicated on the Drawings.
 - .2 Flowerbeds: 150 mm or as indicated on the Drawings.
 - .3 Shrub beds: 150 mm or as indicated on the Drawings.
 - .4 Asphalt paving: As indicated on the Drawings.
 - .5 Concrete paving, Concrete walks: As indicated on the Drawings.
- .3 Slope rough grade away from building minimum 2% or as indicated on the Drawings.
- .4 Grade ditches to depth required for maximum runoff or as indicated on the Drawings.
- .5 Remove soil to a minimum depth of 150 mm from the surface before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding, unless otherwise specified by a professional geotechnical engineer.
- .6 Compact filled and disturbed areas to maximum dry density, in accordance with ASTM D698 or ASTM D1557 if approved by the Consultant:
 - .1 Under landscaped areas: 95%.
 - .2 Under paved and walk areas: 98%.

3.4 SITE QUALITY CONTROL

- .1 Site tests and inspections:
 - .1 Perform in accordance with Section 01 45 00 - Quality Control.
 - .1 Test compact soil in accordance with ASTM D698 to verify conformance with specified requirements.
 - .2 Two to Three tests per 1000 m² of compacted area.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.
- .3 Remove and dispose of surplus material and material that is unsuitable for fill, for grading purposes, or for landscaping purposes.

3.6 PROTECTION

- .1 Maintain finished surfaces until succeeding material is applied or until reviewed by the department representative.

END OF SECTION

**SECTION 31 22 16.13
ROADWAY SUBGRADE RESHAPING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS (NOT USED)

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 DEFINITIONS

- .1 Subgrade: Well-graded and compacted surface, constructed to the grades, lines, and cross-section indicated on Drawings, bladed and compacted to the specified density, preparatory to constructing pavements, or other improvements.
- .2 Scarifying: Loosening the roadbed surface and removing rocks larger than 100 mm. Tilling and manipulating the Subgrade to achieve specified optimum moisture content.

1.4 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
 - .2 ASTM D1557-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with Section 01 57 00 – Temporary Controls for erosion and sediment control measures.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 SCARIFYING AND RESHAPING

- .1 Scarify Subgrade to full width indicated on Drawings and to a minimum depth of 150 mm.
- .2 Pulverize and break down scarified material to maximum 50 mm soil clod size, except stones larger than this size may be left intact as directed by the Departmental Representative.
- .3 Blade and trim pulverized material to elevation and cross section dimensions indicated on Drawings.

- .4 Add and blend additional Subgrade material as directed by the department representative where deficiency of material exists.
 - .1 Subgrade material: Existing subgrade material, Engineered Fill approved by the department representative.
- .5 Re-use excess material in areas of material deficiency.

3.2 COMPACTING

- .1 Compact to maximum dry density to ASTM D698 or ASTM D1557 if approved by the Consultant.
- .2 Shape and roll alternately to obtain smooth, even, and uniformly-compacted Subgrade surface.
- .3 Apply water as necessary during compaction to obtain specified density.
- .4 If material is excessively moist, aerate by Scarifying until moisture content is corrected to value maximum of 2% moisture above optimum value for compaction in accordance with ASTM D698.

3.3 SITE TOLERANCES

- .1 Reshaped compacted surface to be within ± 10 mm of elevation indicated on Drawings.

3.4 PROTECTION

- .1 Protect and maintain reshaped surface in condition conforming to this Section until subsequent material is placed or until receipt of written acceptance from the department representative.

END OF SECTION

**SECTION 31 23 16.26
ROCK REMOVAL**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 – Aggregates for Earthwork
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 DEFINITIONS

- .1 Rock: Solid material in excess of 0.25 m³. Frozen material not classified as rock.
- .2 Peak Particle Velocity (PPV): Maximum speed or velocity reached by a particle in a medium, such as the ground, as a result of a seismic or vibrational event. It is used to quantify the intensity of ground motion caused by various sources, including earthquakes, explosions, construction activities, or industrial processes. PPV is measured in mm/s.

1.4 REFERENCE STANDARDS (NOT USED)

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Regulatory Requirements:
 - .1 Comply with authority having jurisdiction (AHJ) requirements.
- .2 Coordination:
 - .1 Coordinate with Section 01 57 00 – Temporary Controls for erosion and sediment control measures.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

1.7 QUALITY ASSURANCE (NOT USED)

1.8 SITE CONDITIONS (NOT USED)

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 ROCK REMOVAL - GENERAL

- .1 Excavate rock to produce uniform and stable excavation surfaces.
- .2 Excavate trenches to lines, widths, and grades to minimum of 200 mm below pipe inverts indicated on Drawings. Provide recesses for bell and spigot pipes to ensure bearing will occur uniformly along barrel of pipe.
- .3 Remove boulders and fragments which may slide or roll into excavated areas.
- .4 Correct unauthorized rock removal in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling at no extra cost.

3.4 ROCK REMOVAL - MECHANICAL

- .1 Excavate rock using mechanical methods where required.

3.5 ROCK REMOVAL – EXPLOSIVE BLASTING (NOT USED)

3.6 CLEANING

- .1 Waste Management:
 - .1 Manage waste in accordance with Section 01 74 19 – Waste Management and Disposal and:
 - .1 Salvaged Rock:
 - .1 Stockpile suitable rock where instructed by the Departmental Representative and in accordance with Section 31 05 16 – Aggregates for Earthwork.
 - .2 Maintain stockpile site in tidy, well-drained condition, free of standing surface water.
 - .3 Protect stockpiled rock from contamination.
 - .2 Rock Disposal:
 - .1 Dispose of surplus removed rock off site and in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Do not dispose removed rock into landfill. Send material to appropriate quarry or aggregate pit acceptable to the department representative.

END OF SECTION

**SECTION 31 23 33.01
EXCAVATING, TRENCHING AND BACKFILLING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 13 - Selective Site Demolition
- .2 Section 31 05 16 - Aggregates for Earthwork
- .3 Section 32 91 19.13 - Topsoil Placement and Grading
- .4 Section 33 14 16 - Site Water Utility Distribution Piping
- .5 Section 33 31 11 - Public Sanitary Sewerage Gravity Piping
- .6 Section 33 41 16 - Sub-drainage Piping
- .7 Section 33 42 11 – Stormwater Gravity Piping

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 DEFINITIONS

- .1 Industry-average environmental product declaration: Developed by an industry association and represents the average product of multiple companies. Products covered by industry-average environmental product declarations are required to follow the same product category rule. Industry-average environmental product declarations cannot represent a certain manufacturer or its product. Industry-average environmental product declarations may be referred to as "industry-wide environmental product declarations" or "generic environmental product declarations."
- .2 Product-specific type III environmental product declaration: Provides data on one product made by one manufacturer, but can involve multiple factories. Product-specific type III environmental product declarations can cover a product produced by a manufacturer in several plants throughout the world if all plants use the same processes. Product-specific environmental product declarations cannot represent several products or several manufacturers.

1.4 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C117-23, Standard Test Method for Material Finer than 75-µm (No.200) Sieve in Mineral Aggregates by Washing
 - .2 ASTM C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .3 ASTM D422-63e2, Standard Test Method for Particle-Size Analysis of Soils
 - .4 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - .5 ASTM D1557-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

- .6 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric
- .3 CSA Group (CSA):
 - .1 CSA A23.1:19, Concrete materials and methods of concrete construction
 - .2 CSA A3001-18, Cementitious materials for use in concrete
 - .3 CSA B602:20, Mechanical couplings for drain, waste, and vent pipe and sewer pipe
 - .4 CSA B1800:24, Thermoplastic nonpressure piping compendium

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the department representative and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordination with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for French drain piping and fittings, including product characteristics, performance criteria, physical sizes and limitations.
- .3 Samples:
 - .1 Samples for verification:
 - .1 10 kg samples of fill materials.
 - .2 1 kg of fly ash.
 - .2 Submit samples in tightly closed containers to prevent contamination and exposure to elements.
- .4 Source quality control submittals:
 - .1 Inform the department representative, at least 4 weeks before beginning work, of proposed sources of fill materials.
 - .2 Inform the department representative, at least 4 weeks before beginning work, of proposed sources of fly ash.
 - .1 Do not change source of fly ash without written notice of acceptability from the department representative.
- .5 Site quality control submittals: Copies of daily work records to indicate results of compaction tests demonstrating specified densities.
 - .1 Submit within 5 Working Days after completing tests or inspections.

- .6 Sustainable design submittals: Information demonstrating sustainability characteristics specified in this section and in accordance with Section 01 33 29 - Sustainable Design.

1.7 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance instructions and recommended cleaning materials and methods.

1.8 QUALITY ASSURANCE

- .1 Do not use soil material until written report of soil test results are reviewed and approved by department representative.

1.9 SITE CONDITIONS

- .1 Review available site surveys, geotechnical data, and existing hazardous materials information in accordance with Section 00 31 00 - Available Project Information.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Type 1 and Type 2 fills:
 - .1 Crushed, pit run or screened stone, gravel, or sand in accordance with Section 31 05 16 - Aggregates for Earthwork.
 - .2 Gradations to be within limits specified when tested in accordance with ASTM C136M and ASTM C117. Sieve sizes in accordance with CAN/CGSB-8.2.

Sieve Designation	% Passing	
	Select Subgrade Material	19mm Clear Stone
150 mm	100	-
106 mm	-	-
37.5 mm	-	-
26.5 mm	50 to 100	100
19 mm	-	85 to 100
13.2 mm	-	0 to 40
9.5 mm	-	-
4.75 mm	20 to 100	0 to 5
2.36 mm	-	0 to 2
1.18 mm	10 to 100	-

0.300 mm	5 to 95	-
0.150 mm	2 to 65	-
0.075 mm	0 to 25	0 to 1

- .2 Type 3 fill: selected material from excavation or other sources, approved by department representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse, or other deleterious materials.
- .3 Unshrinkable fill: To CSA A3001, Type GU Portland cement, maximum 25 kg/m³ cement content, and 40% fly ash replacement by volume, mixed to settle when placed and resist easy excavation.
 - .1 Concrete aggregate: To CSA A23.1.
 - .2 Performance/design criteria:
 - .1 28 day compressive strength: Maximum 0.4 MPa.
 - .2 24-hour strength: 0.07 MPa.
 - .3 Slump: 160 mm to 200 mm.
 - .3 Unshrinkable fill: Very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.
- .4 Shearmat: Honeycomb-type biodegradable cardboard, 100 mm thick, treated to provide sufficient structural support for poured concrete until concrete is cured.
- .5 French drain piping: To CSA B1800, rigid pipe with 150 mm perforations, complete with fittings.
 - .1 French drain couplings: To CSA B602, compatible with adjoining materials.
- .6 Topsoil: In accordance with Section 32 91 19.13 - Topsoil Placement and Grading.

2.2 SOURCE QUALITY CONTROL

- .1 Non-conforming work:
 - .1 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost-susceptible materials:
 - .1 Fine-grained soils with plasticity index less than 10 when tested in accordance with ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136M: Sieve sizes to CAN/CGSB 8.2.

Sieve Designation % Passing

2.00 mm	100
0.10 mm	45 to 100
0.02 mm	10 to 80

0.005 mm 0 to 45

- .3 Coarse-grained soils containing more than 20% by mass passing 0.075 mm sieve.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Verify conditions in accordance with Section 02 41 13 - Selective Site Demolition.
 - .2 Verify locations of underground services, on and adjacent to site, before beginning work.
- .2 Evaluation and assessment:
 - .1 Photograph existing conditions of adjoining construction and site improvements in accordance with Section 02 41 13 - Selective Site Demolition.

3.2 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Comply with Section 02 41 13 - Selective Site Demolition.
 - .2 Cover and protect soils subject to volume change due to changing moisture content.
- .2 Surface preparation:
 - .1 Prepare surfaces in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Remove obstructions, ice, and snow from surfaces to be excavated within limits indicated.
 - .2 Remove pavement and sidewalks along limits of proposed excavation in accordance with Section 02 41 13.13 - Paving Removal.
- .3 Demolition/removal:
 - .1 Underground services: In accordance with Section 02 41 13 - Selective Site Demolition.

3.3 STRIPPING TOPSOIL

- .1 Begin topsoil stripping areas indicated on Drawings after area has been cleared of brush, weeds, and grasses and removed from site.
- .2 Strip topsoil to depths indicated on Drawings.
- .3 Do not mix topsoil with subsoil.

3.4 STOCKPILING

- .1 Protect fill materials from contamination.
- .2 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

- .3 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .4 Topsoil: Stockpile in locations indicated on Drawings.
 - .1 Maximum stockpile height: 2 m.
- .5 Fill materials: Stockpile fill materials in locations indicated on Drawings.
 - .1 Stockpile granular materials in manner to prevent segregation.
 - .2 Maximum stockpile height: 2 m.

3.5 COFFERDAMS, SHORING, BRACING, AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29 - Health, Safety, and Emergency Response Procedures.
- .2 Construct temporary works to depths, heights, and locations as acceptable to the Departmental Representative.
- .3 During backfill operation:
 - .1 Remove sheeting and shoring from excavations, unless otherwise indicated or directed by the Departmental Representative.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .4 Cut off sheeting tops required to remain in place, at elevations as indicated on Drawings.
- .5 Upon completion of substructure construction:
 - .1 Remove cofferdams, shoring, and bracing.

3.6 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water in accordance with Section 01 71 00 - Examination and Preparation.
- .2 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

3.7 EXCAVATION AND TRENCHING

- .1 Excavation classes:
 - .1 Common excavation: Excavation of materials excluding rock excavation.
 - .2 Rock excavation: Excavation of solid materials in excess of 1 m³ and that cannot be removed by means of heavy-duty mechanical excavating equipment with 0.95 m³ to 1.15 m³ bucket. Frozen material is not classified as rock.
- .2 Excavate and trench to lines, grades, elevations, and dimensions as indicated on Drawings.
- .3 Remove concrete, masonry, paving, walks, demolished foundations, rubble and other obstructions encountered during excavation in accordance with Section 02 41 13 - Selective Site Demolition.

- .4 Trenching: Excavate trenches maximum 30 m ahead of installation; leave maximum 15 m exposed at end of each work day. Obtain department representative's written authorization to exceed these limits.
- .5 Leave excavation and trench soil bottoms undisturbed, level, and free from loose, soft, or organic matter.
- .6 Remove unsuitable material from trench bottoms, including those that extend below required elevations, to extent and depth as directed by the department representative.
- .7 Hand trim, make firm, and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout as acceptable to the Department representative.
- .8 Install geotextiles in accordance with Section 31 32 19.16 - Geotextile Soil Stabilization.
- .9 Site quality control:
 - .1 Site tests and inspections:
 - .1 Arrange for department representative review when bottom of excavation is reached.
 - .2 Non-conforming work:
 - .1 Correct unauthorized over-excavation:
 - .1 Fill under bearing surfaces and footings with Type 3 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.

3.8 FILLING AND COMPACTION

- .1 Use fill types as indicated on Drawings or specified. Compaction densities are percentages of maximum densities obtained from ASTM D698.
 - .1 Exterior sides of perimeter walls: Use Type 3 fill to subgrade level. Compact to 95% of corrected maximum dry density.
 - .2 Within building areas: Use Type 2 to underside of base course for floor slabs. Compact to 100% of corrected maximum dry density.
 - .3 Under concrete slabs: Provide 150 mm compacted thickness base course of Type 1 fill to underside of slab. Compact base course to 100%.
 - .4 Retaining walls: Use Type 2 fill to subgrade level on high side for minimum 500 mm from wall and compact to 95%. Use Type 3 fill compacted to 95% for remaining portions.
 - .5 Place unshrinkable fill in areas as indicated on Drawings.

3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as indicated on Drawings and in accordance with Section 33 14 16 - Site Water Utility Distribution Piping, Section 33 31 11 - Public Sanitary Sewerage Gravity Piping, and Section 33 41 16 - Sub-drainage Piping.
- .2 Place bedding and surround material in unfrozen condition.
- .3 French drains:
 - .1 Slope bedding under French drains minimum 1:100.

- .2 Lay French drain piping with perforations facing downward.
- .3 Backfill with Type 2 fill to maximum 150 mm compacted thickness over pipe.

3.10 BACKFILLING

- .1 Vibratory compaction equipment: Maximum 15kN and 50 Hz.
- .2 Proceed with backfilling operations after:
 - .1 The department representative has reviewed installations and work below finished grades.
 - .2 Inspection, testing, approval of regulatory authorities, and recording location of underground utilities.
 - .3 Removal of concrete formwork.
 - .4 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .3 Verify areas to be backfilled are free from debris, snow, ice, water, and frozen ground.
- .4 Use backfill material that is not frozen or containing ice, snow, or debris.
- .5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated on Drawings. Compact each layer before placing succeeding layer.
- .6 Backfilling around installations:
 - .1 Place bedding and surround material as specified in related technical sections.
 - .2 Allow cast-in-place concrete to cure minimum 24 hours before backfilling.
 - .3 Place layers simultaneously on both sides of installed work to equalize loading. Difference not to exceed 150 mm.
 - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 allow concrete to cure minimum 14 days, or until it has sufficient strength to withstand earth and compaction pressure, or the department representative confirms curing is complete; or
 - .2 if acceptable to the department representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is acceptable to the department representative.
- .7 Place unshrinkable or recycled fill in areas as indicated on Drawings.
- .8 Consolidate and level unshrinkable fill with internal vibrators.
- .9 Install drainage system in backfill as indicated on Drawings.

3.11 RESTORATION

- .1 Restore backfilled areas in accordance with Section 02 41 13 - Selective Site Demolition.

3.12 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal, and:

- .1 Remove and dispose of excavated material unsuitable for use in the work.
- .2 Remove and dispose of surplus excavated materials as indicated on Drawings.

3.13 PROTECTION

- .1 Protect partially installed and completed work from damage in accordance with Section 01 76 00 - Protecting Installed Construction, and:
 - .1 Restrict vehicle operations directly adjacent to open trenches.
 - .2 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
 - .3 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

**SECTION 31 32 19.16
GEOTEXTILE SOIL STABILIZATION**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .2 Section 33 41 16 - Sub-drainage Piping

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM D3787-16, Standard Test Method for Bursting Strength of Textiles—Constant-Rate-of-Traverse (CRT) Ball Burst Test
 - .3 ASTM D4491M-22, Standard Test Methods for Water Permeability of Geotextiles by Permittivity
 - .4 ASTM D4595-23, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Method
 - .5 ASTM D4716M-22, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
 - .6 ASTM D4751-21a, Standard Test Method for Determining Apparent Opening Size of a Geotextile
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-4.2 No. 11.2-M89, Textile Test Methods - Bursting Strength - Ball Burst Test
 - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes
 - .1 No. 2-M85, Methods of Testing Geosynthetics - Mass per Unit Area
 - .2 No. 3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles
 - .3 No. 6.1-93, Methods of Testing Geotextiles and Geomembranes Bursting Strength of Geotextiles Under No Compressive Load
 - .4 No. 7.3-92, Methods of Testing Geotextiles and Geomembranes Grab Tensile Test for Geotextiles
 - .5 No. 10-94, Methods of Testing Geosynthetics: Geotextiles - Filtration Opening Size
- .3 CSA Group (CSA):

- .1 CSA G40.20-13/G40.21-13, General requirements for rolled or welded structural quality steel/Structural quality steel
- .4 Ontario Provincial Standard Specifications (OPSS):
 - .1 OPSS 1860-2019, Material Specification for Geotextiles

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit the following action submittals minimum 4 weeks before starting work of this Section:
 - .1 Product data: Product literature and data sheets for geotextiles, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
 - .2 Samples:
 - .1 Minimum length of 2 m of roll width of geotextile.
 - .2 Methods of joining.
 - .3 Source Quality Control Submittals:
 - .1 Mill test data.
 - .2 Certificates: Certifying materials that comply with specified performance characteristics and physical properties, and signed by the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and:
 - .1 Inspect geotextiles, upon delivery, to confirm materials have good appearance qualities and are free from defects that might affect their specific properties.
 - .2 Store and protect geotextiles from direct sunlight and UV rays.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Geotextiles: Non-woven synthetic fibre fabric, supplied in rolls.
 - .1 Composed of minimum 85%, by mass, of propylene.
 - .2 Width: 2 m minimum.
 - .3 Length: 100 m minimum.
 - .4 Physical properties:
 - .1 Thickness: To CAN/CGSB-148.1, No. 3, minimum 1.5 mm.
 - .2 Mass per unit area: To CAN/CGSB-148.1, No. 2, minimum 150 g/m².
 - .3 Tensile strength and elongation (in any principal direction): To ASTM D4595.
 - .1 Tensile strength: Minimum 400 N, wet condition.
 - .2 Elongation at break: 50-100%.
 - .3 Seam strength: Minimum equal to or greater than tensile strength of fabric.
 - .4 Grab tensile strength and elongation: To CAN/CGSB-148.1, No. 7.3.

- .1 Breaking force: Minimum 400 N, wet condition.
- .2 Elongation at break: 50-100%.
- .5 Ball burst strength: To CAN/CGSB-4.2, No. 11.2, minimum 1500 N, wet condition.
- .6 Bursting strength: To CAN/CGSB-148.1, No.6.1, minimum 1500 kPa, wet condition.
- .5 Hydraulic Properties:
 - .1 Apparent opening size (AOS): To ASTM D4751, 150-425 μm .
 - .2 Filtration opening size (FOS): To CAN/CGSB-148.1 No.10/OPSS 1860, 150-425 μm .
 - .3 Transmissivity: To ASTM D4716/D4716M, minimum 1×10^{-4} to 1×10^{-3} m^2/s .
 - .4 Permittivity: To ASTM D4491/D4491M, 0.5-2.0 per s.
- .6 Factory seams: Sewn in accordance with manufacturer's recommendations.
- .7 Thread for sewn seams: Equal or higher resistance to chemical and biological degradation than geotextile.
- .2 Securing Pins and Washers: To CSA G40.20/G40.21, Grade 300W, hot-dip galvanized with minimum zinc coating of 600 g/m^2 to ASTM A123/A123M.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner, and locations indicated on Drawings. Secure in position with securing pins and washers spaced at 0.6 m on-center.
- .2 Place geotextile material smooth and free of tension stress, folds, wrinkles, and creases.
- .3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .4 Overlap each successive strips of geotextile 600 mm over previously laid strip.
- .5 Pin successive strips of geotextile with securing pins and washers at 0.6 m interval at midpoint of lap.
- .6 Place and compact soil layers in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling and 33 41 16 - Sub-drainage Piping.

3.2 PROTECTION

- .1 Protect installed geotextile material from displacement, damage, or deterioration before, during, and after placement of material layers.
- .2 Vehicular traffic is not permitted directly on geotextile.
- .3 Avoid overloading soil or aggregate on geotextile.
- .4 Replace damaged or deteriorated geotextile to acceptance of the department representative.

END OF SECTION

**SECTION 31 37 00
RIP-RAP**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 – Aggregates for Earthwork
- .2 Section 31 32 19.16 – Geotextile soil stabilization

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C109/C109M-21, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50 mm Cube Specimens)
 - .2 ASTM C144-18, Standard Specification for Aggregate for Masonry Mortar
 - .3 ASTM C185-20, Standard Test Method for Air Content of Hydraulic Cement Mortar
 - .4 ASTM C618-23e1, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - .5 ASTM C952-12, Standard Test Method for Bond Strength of Mortar to Masonry Units
 - .6 ASTM C1506-17, Standard Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters
- .2 CSA Group (CSA):
 - .1 CSA A23.1/A23.2:19, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete
 - .2 CAN/CSA-A179-14, Mortar and grout for unit masonry
 - .3 CSA A3000-18, Cementitious materials compendium

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Product literature and data sheets for stone, geotextile filter, ready-mixed mortar and grout, including product characteristics, performance criteria, physical sizes, finishes, WHMIS SDSs, and limitations.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Stone:

- .1 Hard, dense, durable quarry stone, free from seams, cracks or other structural defects, to meet the following size distribution for use intended:
 - .1 Armour rip-rap:
 - .1 Maximum of 10% of total volume of stones, with individual volume less than 30 dm³.
 - .2 Minimum of 50% of total volume of stones, with individual volume of 225 dm³ or more.
 - .3 Remaining percentage of total volume with uniform distribution of stones between 30 and 225 dm³.
 - .2 Heavy rip-rap:
 - .1 Maximum of 10% of total volume of stones, with individual volume less than 30 dm³.
 - .2 Minimum of 50% of total volume of stones, with individual volume of 140 dm³ or more.
 - .3 Remaining percentage of total volume with uniform distribution of stones between 30 and 140 dm³.
 - .3 Random rip-rap:
 - .1 Maximum of 10% of total volume of stones, with individual volume less than 15 dm³.
 - .2 Minimum of 50% of total volume of stones, with individual volume of 85 dm³ or more.
 - .3 Remaining percentage of total volume with uniform distribution of stones between 15 and 85 dm³.
 - .4 Hand placed rip-rap:
 - .1 Minimum volume of individual stones 10 dm³.
 - .2 Maximum of 75% of total volume of stones with individual volume of 25 dm³ or more.
 - .3 Supply rock spalls or cobbles to fill open joints.
- .2 Geotextile Filter:
 - .1 Geotextile soil stabilization: In accordance with Section 31 32 19.16 - Geotextile Soil Stabilization.
- .3 Bedding Material:
 - .1 Aggregate: Sand, gravel, or crushed rock, well graded, or poor graded with a maximum particle size of 50 mm.
 - .2 Compose material of tough, durable particles.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: In accordance with Section 01 71 00 - Examination and Preparation.

3.2 SURFACE PREPARATION

- .1 Where rip-rap is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated on Drawings.
- .2 Fine grade area to be rip-rapped to uniform, even surface. Fill depressions with suitable aggregate material and compact to provide firm bed.

3.3 PLACING

- .1 Place rip-rap to thickness and details as indicated on Drawings.
- .2 Produce a well graded mass with a maximum 5% of voids, in conformance with lines and grades indicated.
- .3 Place stones in manner acceptable to department representative to secure surface and create a stable mass. Place larger stones at bottom of slopes.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning.
- .2 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.
- .3 Fold up metal banding, flatten and place in designated area for recycling.
- .4 Divert left over aggregate materials from landfill to local facility acceptable to department representative for reuse.

END OF SECTION

**SECTION 32 11 23
AGGREGATE BASE COURSES**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials
- .2 Section 32 11 16.01 - Granular Sub-base

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C117-17, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing
 - .2 ASTM C131/C131M-20, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - .3 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .4 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³)
 - .5 ASTM D1557-12, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³)
 - .6 ASTM D1883-16, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils
 - .7 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric

1.3 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 The Contractor to supply granular base material at pit.

1.4 MEASUREMENT AND PAYMENT

- .1 This item forms part of the stipulated contract lump sum.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Sustainable Design Submittals:
 - .1 Regional Materials: Submit evidence that project incorporates required percentage of regional materials and products, showing their cost, distance from

project to furthest site of extraction or manufacture, and total cost of materials for the Project.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 31 05 16 - Aggregate Materials.
- .2 Storage and Handling Requirements:
 - .1 Stockpile minimum 50% of total aggregate required prior to beginning operation.
 - .2 Store materials in clean dry location and in accordance with manufacturer's recommendations.
 - .3 Store cement in weathertight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment.
- .3 Packaging Waste Management: Remove for reuse by manufacturer of pallets as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Granular base: material in accordance with Section 31 05 16 - Aggregate Materials and the following requirements:
 - .1 Crushed stone or gravel.
 - .2 Gradations to be within limits specified when tested to ASTM C136M and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
 - .1 Gradation Method #2:

Sieve Designation	Granular A	% Passing	
		Granular B (Type 1)	Granular B (Type 2)
150 mm	-	100	-
106 mm	-	-	100
37.5 mm	-	-	-
26.5 mm	100	50-100	50-100
19 mm	85-100	-	-
13.2 mm	65-90	-	-
9.5 mm	50-73	-	-
4.75 mm	35-55	20-100	20-55
1.18 mm	15-40	10-100	10-40

0.300 mm	5-22	2-65	2-22
0.150 mm	-	-	-
0.075 mm	2-8	0-8	0-10

- .2 Gradation Method #2 to: CAN/CGSB-8.2 Granular A, Granular B (Type I) shall not exceed 8% passing 0.075 sieve. Granular B (Type II) shall not exceed 10% passing 0.075mm sieve.
- .3 Liquid limit: To ASTM D4318, maximum 25
- .4 Plasticity index: To ASTM D4318, maximum 6.
- .5 Los Angeles degradation: To ASTM C131/C131M. Max.% loss by weight: 45
- .6 Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least 1 freshly fractured face. Material to be divided into ranges using methods of ASTM C136/C136M.

Passing Retained on

50 mm to 25 mm

25 mm to 19.0 mm

19.0 mm to 4.75 mm

- .7 Soaked CBR: to ASTM D1883, minimum 100, when compacted to 100% of ASTM D1557.

PART 3 EXECUTION

3.1 PLACEMENT AND INSTALLATION

- .1 Place granular base after subgrade surface is inspected and approved in writing by department representative.
- .2 Placing:
 - .1 Construct granular base to depth and grade in areas indicated.
 - .2 Ensure no frozen material is placed.
 - .3 Place material only on clean unfrozen surface, free from snow and ice.
 - .4 Place material using methods which do not lead to segregation or degradation of aggregate.
 - .5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .1 Department representative may authorize thicker lifts (layers) if specified compaction can be achieved.
 - .6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

- .7 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment:
 - .1 Ensure compaction equipment is capable of obtaining required material densities.
 - .2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from department representative before use.
 - .3 Equipped with device that records hours of actual work, not motor running hours.
- .4 Compacting:
 - .1 Compact to density not less than 98% maximum dry density to ASTM D698.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .3 Apply water as necessary during compacting to obtain specified density.
 - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by department representative.
 - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.2 SITE TOLERANCES

- .1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.3 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Divert unused granular material from landfill to local facility approved by department representative.

3.4 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by department representative.

END OF SECTION

**SECTION 32 11 16.01
GRANULAR SUB-BASE**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C117-17, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing
 - .2 ASTM C131M-20, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - .3 ASTM C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .4 ASTM D422-63(2007), Standard Test Method for Particle-Size Analysis of Soils
 - .5 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³)
 - .6 ASTM D1557-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³)
 - .7 ASTM D1883-16, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils
 - .8 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric

1.3 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 Granular based material: supplied by Contractor at pit.

1.4 MEASUREMENT AND PAYMENT

- .1 This item forms part of the stipulated contract lump sum.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:

- .1 Store materials in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Granular sub-base material: in accordance with Section 31 05 16 - Aggregate Materials and the following requirements:

- .1 Crushed, pit run or screened stone, gravel or sand.
- .2 Gradations to be within limits specified when tested to ASTM C136M and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
- .3 Table 1:

Sieve Designation	% Passing		
	Granular A	Granular B (Type 1)	Granular B (Type 2)
150 mm	-	100	-
106 mm	-	-	100
37.5 mm	-	-	-
26.5 mm	100	50-100	50-100
19 mm	85-100	-	-
13.2 mm	65-90	-	-
9.5 mm	50-73	-	-
4.75 mm	35-55	20-100	20-55
1.18 mm	15-40	10-100	10-40
0.300 mm	5-22	2-65	2-22
0.150 mm	-	-	-
0.075 mm	2-8	0-8	0-10

- .4 Other properties as follows:
 - .1 Liquid Limit: to ASTM D4318, Maximum 25.
 - .2 Plasticity Index: to ASTM D4318, Maximum 6.
 - .3 Los Angeles degradation: to ASTM C131M.
 - .1 Maximum loss by mass: 40%.
 - .4 Soaked CBR: to ASTM D1883, Minimum 40 when compacted to 100% of ASTM D1557.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrate previously installed under other Sections or Contracts are acceptable for granular sub-base installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of department representative.
 - .2 Inform department representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from department representative.

3.2 PLACING

- .1 Place granular sub-base after subgrade is inspected and approved by department representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .6 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 - .1 Department representative may authorize thicker lifts if specified compaction can be achieved.
- .7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .8 Remove and replace portion of layer in which material has become segregated during spreading.

3.3 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from department representative before use.
- .3 Equipped with device that records hours of actual work, not motor running hours.
- .4 Compact to density of not less than 98% maximum dry density in accordance with ASTM D698.
- .5 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .6 Apply water as necessary during compaction to obtain specified density.
- .7 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by departmental representative.
- .8 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

3.5 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.6 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by department representative.

END OF SECTION

**SECTION 32 12 10
MARSHALL IMMERSION TEST FOR BITUMEN**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 32 12 16-Asphalt Paving.

1.2 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO T245-97-UL-2004, Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Ministry of Transportation Ontario (MTO)
 - .1 MTO Laboratory Testing Manual-09: LS-283, Resistance to Stripping of Asphalt Cement in Bituminous Mixtures by Immersion Marshall.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples:
 - .1 Submit 1 sample of each proposed asphalt paving mixture. Ensure the sample has enough material for the test preparation in 3.1.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Representative samples of each asphalt paving mixture proposed for use on Project.

2.2 EQUIPMENT

- .1 One or more water baths with automatic controls for immersing specimens. Baths normally used for Marshall Immersion Test are suitable for test.
- .2 Scale and water bath with suitable accessory equipment for weighing test specimens in air and in water to determine their densities.
- .3 Flat transfer plates of glass or metal. Keep 1 plate under each specimen during immersion period and during subsequent handling, except when weighing and testing, to prevent breakage or distortion of specimens.
- .4 Apparatus required to conduct Marshall Immersion Test.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Prepare at least 8 specimens for each test with a hand-operated hammer, in accordance with AASHTO T245-97-UL and LS-283, except where specified otherwise.

3.2 TEST PROCEDURE

- .1 Do Marshall testing to AASHTO T245-97-UL.
- .2 Weigh each specimen in air and in water. Weigh in water as rapidly as possible to minimize absorption.
- .3 Calculate specific gravity of each specimen as follows:
 - .1 Specific Gravity = $A/A-B$
 - .2 Where A = weight of specimen in air in grams
 - .3 B = weight of specimen in water in grams
- .4 Sort each set of 8 specimens into 2 groups of 4 specimens each so that average specific gravity of specimens in group 1 is essentially same as that of group 2.
- .5 Test group 1 specimens for Marshall stability. Calculate S1 = Marshall stability of group 1 (average).
- .6 Immerse group 2 specimens in water for 24 hours at 60 degrees C, then test immediately for Marshall stability. Calculate S2 = Marshall stability of group 2 (average).

3.3 CLOSEOUT ACTIVITIES

- .1 Report test results to department representative.
- .2 Report numerical index of retained stability as resistance of asphaltic paving mixtures to detrimental effect of water, expressed as percentage of original stability retained after immersion period.
- .3 Calculate index as follows:
 - .1 Index of Retained Stability = $S2/S1 \times 100$.

END OF SECTION

**SECTION 32 12 16
ASPHALT PAVING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials General
- .2 Section 32 12 10 - Marshall Immersion Test for Bitumen
- .3 Section 32 12 13.16 - Asphalt Tack Coats
- .4 Section 32 12 13.23 - Asphalt Prime Coats

1.2 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO):
 - .1 AASHTO M320-21, Standard Specification for Performance Graded Asphalt Binder
 - .2 AASHTO R29-15, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder
 - .3 AASHTO T245-15, Standard Method of Test for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus
- .2 Asphalt Institute (AI):
 - .1 AI MS-2-1994, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types
- .3 ASTM International (ASTM):
 - .1 ASTM C88/C88M-18, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate
 - .2 ASTM C117-17, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing
 - .3 ASTM C123/C123M-14, Standard Test Method for Lightweight Particles in Aggregate
 - .4 ASTM C127-15, Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate
 - .5 ASTM C128-15, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
 - .6 ASTM C131/C141M-20, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - .7 ASTM C136/C136M-19, Standard Method for Sieve Analysis of Fine and Coarse Aggregates
 - .8 ASTM C207-18, Standard Specification for Hydrated Lime for Masonry Purposes
 - .9 ASTM D995-95b, Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

- .10 ASTM D2419-14, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- .11 ASTM D3203/C3203M-17, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
- .12 ASTM D4791-19, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- .4 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series
 - .2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric

1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- .1 Notify department representative and supplier authorized to release material of proposed date for use of materials; order and schedule shipments to coincide with construction schedule.

1.4 MEASUREMENT AND PAYMENT

- .1 This item forms part of the stipulated contract lump sum.

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, printed product literature and data sheets for asphalt mixes and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175 degrees C 4 weeks before beginning work.
- .3 Samples:
 - .1 Inform department representative of proposed source of aggregates and provide access for sampling 4 weeks before beginning work.
 - .2 Submit samples of the following materials proposed for use 4 weeks before beginning work.
 - .1 Two 2 L container of asphalt cement.
 - .2 1 kg of hydrated lime.
- .4 Test and Evaluation Reports:
- .5 Certificates:
 - .1 Certification to be marked on pipe.
- .6 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification that asphalt cement meets specification requirements.
 - .2 Submit asphalt concrete mix design and trial mix test results to department representative for review at least 4 weeks before beginning work.
 - .3 Submit printed record of mix temperatures at end of each day.
- .7 Sustainable Design Submittals:

- .1 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for the Project.
 - .2 Submit evidence, when Supplementary Cementing Materials (SCMs) are used, to certify reduction in cement from Base Mix to Actual SCMs Mix, as percentage.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Submit to department representative copies of freight and waybills for asphalt cement as shipments are received.
 - .1 department representative reserves right to check weights as material is received.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Performance graded asphalt cement: To AASHTO M320, grade PG 58 - 28 when tested to AASHTO R29.
- .2 Aggregates: in accordance with Section 31 05 16 - Aggregate Materials General and requirements as follows:
 - .1 Crushed stone or gravel.
 - .2 Gradations: within limits specified when tested to ASTM C136/C136M and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
 - .3 Table:

Sieve Designation Lower Course Surface Course

25 mm	-	-
19 mm	100	-
16 mm	98-100	100
13.2	83-95	98-100
9.5 mm	62-82	75-90
4.75 mm	45-60	50-60
2.36 mm	27-60	36-60
1.18 mm	16-60	25-58
0.600 mm	8-47	16-45
0.300 mm	4-27	7-26

0.150 mm	1-10	3-10
0.075 mm	0-6	0-5

- .4 Coarse Aggregate: Aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C136M.
- .5 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75 mm sieve and stockpile separately from coarse aggregate.
- .6 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .7 Sand equivalent: ASTM D2419. Min: 50.
- .8 Magnesium Sulphate soundness: To ASTM C88M. Max% loss by mass:
 - .1 Coarse aggregate surface course: 12%
 - .2 Coarse aggregate lower course: 12%
 - .3 Fine aggregate, surface course: 16%
 - .4 Fine aggregate, lower course: 16%
- .9 Los Angeles degradation: Grading B, to ASTM C131M. Max% loss by mass:
 - .1 Coarse aggregate, surface course: 25%
 - .2 Coarse aggregate, lower course: 35%
- .10 Absorption: To ASTM C127. Max% by mass:
 - .1 Coarse aggregate, surface course: 1.75%
 - .2 Coarse aggregate, lower course: 2.00%
- .11 Loss by washing: To ASTM C117. Max% passing 0.075 mm sieve:
 - .1 Coarse aggregate, surface course: 1.5%
 - .2 Coarse aggregate, lower course: 2.0%
- .12 Lightweight particles: To ASTM C123M. Max% by mass less than 1.95 relative density:
 - .1 Surface course: 1.5%
 - .2 Lower course: 3.0%
- .13 Flat and elongated particles: To ASTM D4791, (with length to thickness ratio greater than 5): Max% by mass:
 - .1 Coarse aggregate, surface course: 15%
 - .2 Coarse aggregate, lower course: 15%
- .14 Crushed fragments: At least 60% of particles by mass within each of the following sieve designation ranges, to have 1 minimum freshly fractured face. Material to be divided into ranges, using methods of ASTM C136M.

Passing Retained on

25 mm to 12.5 mm

12.5 mm to mm

- .15 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .3 Mineral filler:
 - .1 Ensure finely ground particles of limestone, hydrated lime, Portland cement or non-plastic mineral matter approved by department representative are thoroughly dry and free from lumps.
 - .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed by department representative to improve mix properties.
 - .3 Ensure mineral filler is dry and free flowing when added to aggregate.
- .4 Anti-stripping agent: Hydrated lime to ASTM C207 type N.
 - .1 Add lime at rate of approximately 2-3% of dry weight of aggregate.
- .5 Water: To approval of department representative.

2.2 EQUIPMENT

- .1 Pavers: Mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: Sufficient number of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
 - .1 Drum diameter: 1200 mm minimum.
 - .2 Amplitude of vibration (machine setting): 0.5 mm maximum for lifts less than 40 mm thick.
- .4 Haul trucks: Sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
 - .4 Use only trucks which can be weighed in single operation on scales supplied.
- .5 Hand tools:
 - .1 Lutes or rakes with covered teeth for spreading and finishing operations.
 - .2 Tamping irons having mass 12 kg minimum and bearing area not exceeding 310 cm² for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by department representative, may be used instead of tamping irons.
 - .3 Straight edges, 4.5 m in length, to test finished surface.

2.3 MIX DESIGN

- .1 Mix design to be approved in writing by department representative.

- .2 Mix design to be developed by testing laboratory approved in writing by department representative.
- .3 Design of mix: by Marshall method to requirements below.
 - .1 Compaction blows on each face of test specimens: 50.
 - .2 Mix physical requirements:

Property	Roads
Marshall Stability at 60 degrees C kN min	8.9 surface course/ 8.0 lower course
Flow Value mm	1.6
Air Voids in Mixture,%	3.5-4.5 surface course
Voids in Mineral Aggregate,% min	14 surface course/ 13 lower course
Index of Retained Stability% minimum	75

- .3 Measure physical requirements as follows:
 - .1 Air voids: To ASTM D3203M.
 - .2 Voids in mineral aggregates: To MS2.
 - .3 Index of Retained Stability: Measure in accordance with Section 32 12 10 - Marshall Immersion Test for Bitumen.
- .4 Do not change job-mix without prior approval of department representative. When change in material source proposed, new job-mix formula will be provided to be reviewed by department representative.

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 asphalt paving in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of department representative.
 - .2 Inform department representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the department representative.

3.2 PLANT AND MIXING REQUIREMENTS

- .1 Batch and continuous mixing plants:
 - .1 To ASTM D995.
 - .2 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders.
 - .1 Do not load frozen materials into bins.
 - .3 Feed cold aggregates to plant in proportions to ensure continuous operations.

- .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
- .5 Before mixing, dry aggregates to moisture content not greater than 1% by mass or to lesser moisture content if required to meet mix design requirements. Heat to temperature required to meet mixing temperature as directed by departmental representative.
- .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
- .7 Store hot screened aggregates in manner to minimize segregation and temperature loss.
- .8 Heat asphalt cement and aggregate to mixing temperature directed by departmental representative. Do not heat asphalt cement above 160 degrees C.
- .9 Make available current asphalt cement viscosity data at plant. With information relative to viscosity of asphalt being used, departmental representative to approve temperature of completed mix at plant and at paver after considering hauling and placing conditions.
- .10 Maintain temperature of materials within 5 degrees C of specified mix temperature during mixing.
- .11 Mixing time:
 - .1 In batch plants, both dry and wet mixing times as directed by departmental representative. Continue wet mixing as long as necessary to obtain thoroughly blended mix but not less than 30s or more than 75s.
 - .2 In continuous mixing plants, mixing time as directed by departmental representative but not less than 45s.
 - .3 Mixing time as directed by departmental representative.
- .2 Dryer drum mixing plant:
 - .1 To ASTM D995.
 - .2 Load aggregates from individual stockpiles to separate cold feed bins. Do not load frozen materials into bins.
 - .3 Feed aggregates to burner end of dryer drum by means of multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
 - .4 Meter total flow of aggregate using electronic weigh belt system with indicator that can be monitored by plant operator and which is interlocked with asphalt pump to ensure proportions of aggregate and asphalt entering mixer remain constant.
 - .5 Allow for easy calibration of weighing systems for aggregates without having material enter mixer.
 - .6 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
 - .1 Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time.
 - .2 Difference between this value and amount shown by plant computer system to differ by not more than plus or minus 2%.
 - .7 Make provision for conveniently sampling full flow of materials from cold feed.

- .8 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate from cold feed before entering drum.
- .9 Provide system interlock stop on feed components if either asphalt or aggregate from bin stops flowing.
- .10 Accomplish heating and mixing of asphalt mix in approved parallel flow dryer-mixer in which aggregate enters drum at burner end and travels parallel to flame and exhaust gas stream.
 - .1 Control heating to prevent fracture of aggregate or excessive oxidation of asphalt.
 - .2 Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with printing recorder that can be monitored by plant operator.
 - .3 Submit printed record of mix temperatures at end of each day.
- .11 Ensure mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer is 2% maximum.
- .3 Temporary storage of hot mix:
 - .1 Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
 - .2 Do not store asphalt mix in storage bins in excess of 3 hours.
- .4 While producing asphalt mix for this Project, do not produce mix for other users unless separate storage and pumping facilities are provided for materials supplied to this project.
- .5 Mixing tolerances:
 - .1 Permissible variation in aggregate gradation from job mix (percent of total mass).
 - 4.75 mm sieve and larger
 - 2.00 mm sieve
 - 0.425 mm sieve
 - 0.180 mm sieve
 - 0.075 mm sieve 2.0
 - .2 Permissible variation of asphalt cement from job mix: 0.25%.
 - .3 Permissible variation of mix temperature at discharge from plant: [5] degrees C.
- .6 Addition of anti-stripping agent:
 - .1 Plant to be equipped with pug mill to thoroughly mix aggregates and lime before entering the plant.
 - .2 Plant to be equipped with suitable conveyor systems capable of supplying aggregates and lime at constant rate.
 - .3 Plant and equipment used for addition of lime to be equipped with covers to control loss of lime.
 - .4 Plant to be equipped to control rate of lime incorporation to within 1/4%.

- .5 Add water to aggregate before entering pug mill.
- .6 Add water to lime sufficiently in advance to permit time to slake before entering pug mill.

3.3 PREPARATION

- .1 When paving over existing asphalt surface, clean pavement surface in accordance with Section 32 01 11.01 - Pavement Cleaning and Marking Removal.
 - .1 When levelling course is not required, patch and correct depressions and other irregularities to approval of department representative before beginning paving operations.
- .2 Apply tack coat in accordance with Section 32 12 13.16 - Asphalt Tack Coats before paving.
- .3 Before laying mix, clean surfaces of loose and foreign material.

3.4 TRANSPORTATION OF MIX

- .1 Transport mix to job site in vehicles cleaned of foreign material.
- .2 Paint or spray truck beds with limewater, soap or detergent solution, or non petroleum based commercial product, at least daily or as required.
 - .1 Raise truck bed and thoroughly drain, and ensure no excess solution remains in truck bed.
- .3 Schedule delivery of material for placing in daylight, unless department representative approves artificial light for night placing.
- .4 Deposit mix from surge or storage silo to trucks in multiple drops to reduce segregation.
 - .1 Do not dribble mix into trucks.
- .5 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.
- .6 Deliver loads continuously in covered vehicles and immediately spread and compact.
 - .1 Deliver and place mixes at temperature within range as directed by department representative, but not less than 135 degrees C.

3.5 PLACING

- .1 Obtain department representative's approval of granular road base or base course and tack coat before placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as indicated in the contract drawings.
- .3 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is 5 degrees C minimum.
 - .2 When temperature of surface on which material is to be placed falls below 10 degrees C, provide extra rollers as necessary to obtain required compaction before cooling.
 - .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as follows:
 - .1 Lower course in 1 layer of 40 mm.

- .2 Surface course in 1 layer of maximum 40 mm.
- .5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 500 mm.
- .6 Spread and strike off mixture with self propelled mechanical finisher.
 - .1 Construct longitudinal joints and edges true to line markings.
 - .1 department representative to establish lines for paver to follow parallel to centerline of proposed pavement. Position and operate paver to follow established line closely.
 - .2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver.
 - .1 Work pavers as close together as possible and in no case permit them to be more than 30 m apart.
 - .3 Maintain constant head of mix in auger chamber of paver during placing.
 - .4 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
 - .5 Correct irregularities in alignment left by paver by trimming directly behind machine.
 - .6 Correct irregularities in surface of pavement course directly behind paver.
 - .1 Remove excess material forming high spots using shovel or lute.
 - .1 Fill and smooth indented areas with hot mix.
 - .2 Do not broadcast material over such areas.
 - .7 Do not throw surplus material on freshly screeded surfaces.
- .7 When hand spreading is used:
 - .1 Use approved wood or steel forms, rigidly supported to assure correct grade and cross section.
 - .1 Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
 - .2 Distribute material uniformly without broad casting material.
 - .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes.
 - .1 Reject material that has formed into lumps and does not break down readily.
 - .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
 - .5 Provide heating equipment to keep hand tools free from asphalt.
 - .1 Control temperature to avoid burning material.
 - .2 Do not use tools at higher temperature than temperature of mix being placed.

3.6 COMPACTING

- .1 Do not change rolling pattern unless mix changes or lift thickness changes.
 - .1 Change rolling pattern only as directed by department representative.

- .2 Roll asphalt continuously to density not less than 92% - 96.5% of 50 blow Marshall density to AASHTO T245.
- .3 General:
 - .1 Provide at least 2 rollers and as many additional rollers as necessary to achieve specified pavement density. When more than 2 rollers are required, 1 roller must be pneumatic tired type.
 - .2 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.
 - .3 Operate roller slowly initially to avoid displacement of material. Do not exceed 5 km/h for breakdown and intermediate rolling for static steel-wheeled and pneumatic tired rollers. Do not exceed 9 km/h for finish rolling.
 - .4 Use static compaction for levelling coarse less than 25 mm thick.
 - .5 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 25 impacts per meter of travel. For lifts less than 50 mm thick, impact spacing not to exceed compacted lift thickness.
 - .6 Overlap successive passes of roller by minimum of 200 mm and vary pass lengths.
 - .7 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
 - .8 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
 - .9 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
 - .10 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.
 - .1 Ensure that all points across width of pavement receive essentially equal numbers of passes of compactors.
 - .11 When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.
 - .12 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.
- .4 Breakdown rolling:
 - .1 Begin breakdown rolling with static steel wheeled roller immediately following rolling of transverse and longitudinal joint and edges.
 - .2 Operate rollers as close to paver as necessary to obtain adequate density without causing undue displacement.
 - .3 Operate breakdown roller with drive roll or wheel nearest finishing machine. When working on steep slopes or super-elevated sections use operation approved by Departmental Representative.
 - .4 Use only experienced roller operators.
- .5 Intermediate rolling:
 - .1 Use pneumatic-tired, steel wheel or vibratory rollers and follow breakdown rolling as closely as possible and while paving mix temperature allows maximum density from this operation.

- .2 Rolling to be continuous after initial rolling until mix placed has been thoroughly compacted.
- .6 Finish rolling:
 - .1 Accomplish finish rolling with two-axle or three-axle tandem steel wheeled rollers while material is still warm enough for removal of roller marks.
 - .1 If necessary to obtain desired surface finish, use pneumatic-tired rollers as directed by Departmental Representative.
 - .2 Conduct rolling operations in close sequence.

3.7 JOINTS

- .1 General:
 - .1 Remove surplus material from surface of previously laid strip.
 - .1 Do not deposit on surface of freshly laid strip.
 - .2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as indicated.
 - .3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material before placing adjacent pavement.
- .2 Transverse joints:
 - .1 Offset transverse joint in succeeding lifts by at least 600 mm.
 - .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt before continuing paving.
 - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
- .3 Longitudinal joints:
 - .1 Offset longitudinal joints in succeeding lifts by at least 150 mm.
 - .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100 degrees C before paving of adjacent lane.
 - .1 For airfield runway paving, avoid cold joint construction in mid 30 m of runway.
 - .2 If cold joint can not be avoided, cut back by saw cutting previously laid lane, by at least 150 mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
 - .3 Overlap previously laid strip with spreader by 25 to 50 mm.
 - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
 - .5 Roll longitudinal joints directly behind paving operation.
 - .6 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 150 mm extending onto previously placed and compacted lane.
- .4 Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix.
 - .1 Place and compact joint to ensure joint is smooth and without visible breaks in grade.

- .5 Construct butt joints as indicated.

3.8 FINISH TOLERANCES

- .1 Finished asphalt surface to be within 5 mm of design elevation but not uniformly high or low.
- .2 Finished asphalt surface not to have irregularities exceeding 5 mm when checked with 4.5 m straight edge placed in any direction.

3.9 DEFECTIVE WORK

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required.
 - .1 If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.
- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.10 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

**SECTION 32 12 13.16
ASPHALT TACK COATS**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 32 12 16 – Asphalt Paving.

1.2 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M081-92-UL-04, Standard Specification for Cutback Asphalt (Rapid-Curing Type).
- .2 ASTM International
 - .1 ASTM D140/D140M-09, Standard Practice for Sampling Bituminous Materials.
 - .2 ASTM D633-11, Standard Volume Correction Table for Road Tar.
 - .3 ASTM D1250-08, Standard Guide for Use of the Petroleum Measurement Tables.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.

1.3 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 Departmental Representative will supply:
 - .1 Asphalt tack coat material delivered by tank truck.

1.4 MEASUREMENT AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

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, printed product literature and data sheets for asphalt tack coat and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit two - 4 L samples of asphalt tack coat material proposed for use in new, clean, airtight, sealed, wide mouth jars, bottles made with plastic, or plastic lined cans to department representative, at least 2 weeks prior to beginning Work.
 - .2 Sample asphalt tack coat material to: ASTM D140.
 - .3 Provide access on tank truck for department representative to sample asphalt material to be incorporated into Work to ASTM D140.

1.6 QUALITY ASSURANCE

- .1 Upon request from department representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .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 asphalt tack coats from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Deliver, store and handle materials in accordance with ASTM D140.
- .5 Provide, maintain and restore asphalt storage area.
- .6 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Anionic emulsified asphalt: to CAN/CGSB-16.2, grade: SS-1h.
- .2 Cut-back asphalt; to AASHTO M081-92-UL, grade RC-70 or RC-250.
- .3 Water: clean, potable, free from foreign matter.

2.2 EQUIPMENT

- .1 Equipment required for Work of this Section to be in satisfactory working condition and maintained for duration of Work.
- .2 Pressure distributor:
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5 m.
 - .3 Applied at readily determined and controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and with allowable variation from any specified rate not exceeding 0.1 L/m².
 - .4 Distribute in uniform spray without atomization at temperature required.

- .2 Equipped with meter, registering travel in metres per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
- .3 Equipped with pump having flow metre graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
- .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .1 Measure temperature to closest whole number.
- .5 Equipped with accurate volume measuring device or calibrated tank.
- .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
- .7 Equipped with nozzle spray bar, with operational height adjustment in increments of 0.6 metres and capable of being raised or lowered.
- .8 Cleaned if previously used with incompatible asphalt material.

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 asphalt tack coat installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of department representative.
 - .2 Inform department representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from department representative.

3.2 APPLICATION

- .1 Apply asphalt tack coat only on clean and dry surface.
- .2 Dilute asphalt emulsion with water at 1:1 ratio for application.
 - .1 Mix thoroughly by pumping or other method approved by departmental representative.
- .3 Apply asphalt tack coat evenly to pavement surface at rate as directed by departmental representative, between 0.09 and 0.5 L/m² but not to exceed 0.7 L/m².
- .4 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt tack coat material.
- .5 Apply asphalt tack coat only when air temperature greater than 10 degrees C and when rain is not forecast within 2 hours minimum of application.
- .6 Apply asphalt tack coat only on unfrozen surface.
- .7 Evenly distribute localized excessive deposits of tack coat by brooming as directed by Departmental Representative.
- .8 Where traffic is to be maintained, treat no more than one half of width of surface in one application.
 - .1 Control traffic in accordance with Section 01 55 26 - TRAFFIC CONTROL.

- .9 Keep traffic off tacked areas until asphalt tack coat has set.
- .10 Re-tack contaminated or disturbed areas as directed by department representative.
- .11 Permit asphalt tack coat to set break before placing asphalt pavement.
- .12 Submit summary report within 7 days minimum of date of application and include information as follows:
 - .1 Total area tack coated.
 - .2 Quantity of tack coat used.
 - .3 Mean application rate.
 - .4 Actual product quantity used when using equipment on pressure distributors.
 - .5 Dipstick measurements or electronic printouts are acceptable.
- .13 Carry out measurements in presence of department representative upon request.
- .14 Inspect tack coat application to ensure uniformity.
 - .1 Re-spray areas of insufficient or non-uniform tack coat coverage as directed by department representative.
 - .2 Ensure tack coating performed using hand held devices is consistent in appearance with adjacent areas of machine applied material.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal Requirements.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

**SECTION 32 12 16.02
ASPHALT PAVING FOR BUILDING SITES**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 32 12 16 – Asphalt Paving
- .2 Section 31 05 16 - Aggregate Materials
- .3 Section 32 12 10 - Marshall Immersion Test for Bitumen
- .4 Section 32 12 13.16 - Asphalt Tack Coats

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C88/C88M-18, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate
 - .2 ASTM C117-17, Standard Test Method for Material Finer Than 0.075 (No. 200) mm Sieve in Mineral Aggregates by Washing
 - .3 ASTM C123/C123M-14, Standard Test Method for Lightweight Particles in Aggregate
 - .4 ASTM C127-15, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
 - .5 ASTM C128-15, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
 - .6 ASTM C131/C131M-20, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - .7 ASTM C136/C136M-19, Standard Method for Sieve Analysis of Fine and Coarse Aggregates
 - .8 ASTM D698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³)
 - .9 ASTM D995-95b, Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
 - .10 ASTM D1557-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³)
 - .11 ASTM D1559-89, Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
 - .12 ASTM D2419-14, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
 - .13 ASTM D3203/D3203M-17, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

- .14 ASTM D4318-17e1, Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
- .15 ASTM D4791-19, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- .2 Asphalt Institute (AI):
 - .1 AI MS-2-94, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series
 - .2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric

1.3 MEASUREMENT AND PAYMENT

- .1 This item forms part of the stipulated contract lump sum.

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 asphalt paving mix, aggregate, and coatings and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit asphalt concrete mix design and trial mix test results for review.
 - .2 Inform department representative and Owner of proposed source of aggregates and provide access for sampling at least 4 weeks before commencing work.
 - .3 Submit samples of following materials proposed for use at least 4 weeks before commencing work:
 - .1 Two 2 L containers of asphalt cement.
- .4 Test and Evaluation Reports:
 - .1 Materials to be tested by third party testing laboratory approved by department representative.
 - .2 Submit test certificates showing suitability of materials at least 4 weeks before commencing work.
- .5 Sustainable Design Submittals:
 - .1 Regional Materials: Submit evidence that the Project incorporates required percentage of regional materials and products, showing their cost, distance from the Project to furthest site of extraction or manufacture, and total cost of materials for the Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect aggregate from damage.

- .3 Packaging Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Granular base and sub-base material: To Section 31 05 16 - Aggregate Materials and following requirements:

- .1 Crushed or screened stone, gravel or sand.
- .2 Gradations: within limits specified when tested to ASTM C136M and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
- .3 Table 1:

Sieve Designation Granular Base Granular Sub-Base

150 mm	-	100
106 mm	-	-
37.5 mm	-	-
26.5 mm	100	50-100
19 mm	85-100	-
13.2 mm	65-90	-
9.5 mm	50-73	-
4.75 mm	35-55	20-100
1.18 mm	15-40	10-100
0.300 mm	5-22	2-65
0.150 mm	-	-
0.075 mm	2-8	0-8

- .4 Granular base aggregates:
- .1 Crushed particles: at least 60% of particles by mass retained on 4.75 mm sieve to have at least 1 freshly fractured face.
- .2 Liquid limit: To ASTM D4318, maximum 25.
- .3 Plasticity index: To ASTM D4318, maximum 6.
- .2 Asphalt concrete aggregates:
- .1 Coarse aggregate is aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C117.

- .2 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75 mm sieve and stockpile separately from coarse aggregate.
- .3 Separate stock piles for coarse and fine aggregate are not required for sheet asphalt.
- .4 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .5 Aggregate: material to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed stone or gravel.
 - .2 Gradations to be within limits specified when tested to ASTM C136M and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
 - .3 Table 2:

Sieve Designation Lower Course Surface Course

25 mm	-	-
19 mm	100	-
16 mm	98-100	100
13.2	83-95	98-100
9.5 mm	62-82	75-90
4.75 mm	45-60	50-60
2.36 mm	27-60	36-60
1.18 mm	16-60	25-58
0.600 mm	8-47	16-45
0.300 mm	4-27	7-26
0.150 mm	1-10	3-10
0.075 mm	0-6	0-5

- .4 Sand equivalent: To ASTM D2419, Minimum 50.
- .5 Magnesium Sulphate soundness: To ASTM C88M. Max% loss by weight: coarse aggregate 12, fine aggregate 16.
- .6 Los Angeles Degradation: To ASTM C131M. Max% loss by weight: coarse aggregate, 35.
- .7 Absorption: To ASTM C127. Max% by weight: coarse aggregate, 1.75.
- .8 Lightweight particles: To ASTM C123/C123M. Max% by mass, with less than 1.95. Relative density (formally Specific Gravity): 1.5.

- .9 Flat and elongated particles: To ASTM D4791, (with length to thickness ratio greater than 5): Max% by weight: coarse aggregate, 15.
- .10 Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least 1 freshly fractured face. Material to be divided into ranges using methods of ASTM C136M.

Table 3:

Passing Retained on

19 mm to 9.5 mm

9.5 mm to 4.75 mm

- .11 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .3 Mineral filler for asphalt concrete:
 - .1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.
 - .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed by department representative to improve mix properties.
- .4 Asphalt tack coat: To 32 12 1316-Asphalt Tack Coats.

2.2 EQUIPMENT

- .1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers for parking lots and driveways:
 - .1 Minimum drum diameter: 750 mm.
 - .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.
- .4 Haul trucks: of sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
- .5 Suitable hand tools.

2.3 MIX DESIGN

- .1 Mix design to AI MS-2.
- .2 Job mix formula to be approved by department representative.
- .3 Design of mix: by Marshall method to requirements below:

- .1 Compaction blows on each face of test specimens: 50.
- .2 Mix physical requirements:

Property	Parking Lots
Marshall Stability at 60 degrees C, kN minimum.	8.9 surface course/ 8.0 lower course
Flow Value, mm.	1.6
Air Voids in Mixture, %	3.5-4.5 surface course
Voids in Mineral Aggregate, % minimum	14 surface course/ 13 lower course
Index of Retained Stability, % minimum	75

- .3 Measure physical requirements as follows:
 - .1 Marshall load and flow value: To ASTM D1559.
 - .2 Air voids: To ASTM D3203M.
 - .3 Voids in mineral aggregate: To AI MS-2, chapter 4.
 - .4 Index of Retained Stability: Measure in accordance with Section 32 12 10 - Marshall Immersion Test for Bitumen.
- .4 Do not change job-mix without prior approval of department representative. When change in material source proposed, new job-mix formula will be provided to the department representative for approval.
- .5 Return plant dust collected during processing to mix in quantities acceptable to Departmental Representative.

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 asphalt paving installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of department representative.
 - .2 Inform department representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from department representative.

3.2 SUBGRADE AND SURFACE PREPARATION AND INSPECTION

- .1 Verify grades of subgrade drains and other items set in paving area for conformity with elevations and sections before placing granular base and sub-base material. If asphalt concrete is to be placed directly on existing asphalt concrete, ensure surface is clean, dry, and asphalt tack coat is applied. Refer to 32 12 1316-Asphalt Tack Coats.
- .2 Obtain written approval of subgrade by department representative before placing granular sub-base and base.

3.3 GRANULAR SUB-BASE AND GRANULAR BASE

- .1 Place granular base and sub-base material on clean unfrozen surface, free from snow and ice.
- .2 Place granular base and sub-base to compacted thicknesses as indicated. Do not place frozen material.
- .3 Place in layers not exceeding 150mm compacted thickness. Compact to density not less than 98% corrected maximum dry density ASTM D698.
- .4 Finished base surface to be within 10 mm of specified grade, but not uniformly high or low.

3.4 ASPHALT PRIME

- .1 Emulsified asphalt:
 - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application. Mix thoroughly by pumping or other method approved in writing by Departmental Representative.
 - .2 Apply diluted asphalt emulsion at rate directed by Departmental Representative but do not exceed 5 L/m².
 - .3 Apply on damp surface unless directed by Departmental Representative.
- .2 Do not apply primer when air temperature is below 5 degrees C or when rain is forecast within 2 hours.
- .3 If asphalt prime fails to set, spread sand blotter material in amounts required to absorb excess material. Sweep and remove excess blotter material.

3.5 ASPHALT TACK COAT

- .1 In accordance with Section 32 12 13.16 - Asphalt Tack Coats.

3.6 PLANT AND MIXING REQUIREMENTS

- .1 In accordance with ASTM D995.

3.7 ASPHALT CONCRETE PAVING

- .1 Obtain written approval of tack coat from department representative before placing asphalt mix.
- .2 Place asphalt mix only when base or previous course is dry and air temperature is above 5 degrees C.
- .3 Place asphalt concrete in compacted layers as per the contract drawings.
- .4 Minimum 135 degrees C mix temperature required when spreading.
- .5 Maximum 160 degrees C mix temperature permitted at any time.
- .6 Compact each course with roller as soon as it can support roller weight without undue cracking or displacement.
- .7 Compact parking lot asphalt concrete to density between 92% and 96.5% of density obtained with Marshall specimens prepared in accordance with ASTM D1559 from samples of mix being used. Roll until roller marks are eliminated.
- .8 Keep roller speed slow enough to avoid mix displacement and do not stop roller on fresh pavement.
- .9 Moisten roller wheels with water to prevent pick up of material.

- .10 Compact mix with hot tampers or other equipment approved in writing by Departmental Representative, in areas inaccessible to roller.
- .11 Finish surface to be within 10 mm of design elevation and with no irregularities greater than 10 mm in 4.5 m.
- .12 Repair areas showing checking, rippling or segregation as directed by department representative.

3.8 JOINTS

- .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.
- .2 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material before placing adjacent pavement.
- .3 For cold joints, cut back to full depth vertical face and tack face with hot asphalt.
- .4 For longitudinal joints, overlap previously laid strip with spreader by 25 to 50 mm.

3.9 ASPHALTIC CURBS

- .1 Form asphalt curbs by machine to profiles as indicated. Curve curbs uniformly.

3.10 SPEED BUMPS

- .1 Form speed-limiting bumps as indicated. Stop bumps 300 mm short of curb.

3.11 TESTING

- .1 Inspection and testing of asphalt pavement will be carried out by designated testing laboratory in accordance with Section 01 45 00 - Quality Control.
- .2 Costs of tests will be paid under Contract Allowance.

3.13 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

3.14 PROTECTION

- .1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38 degrees C.
 - .1 Do not permit stationary loads on pavement until 24 hours after placement.
- .2 Provide access to buildings as required.
 - .1 Arrange paving schedule so as not to interfere with normal use of premises.

END OF SECTION

**SECTION 32 15 60
ROADWAY DUST CONTROL**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 22 13-Rough Grading, Section 32 11 23-Aggregate Base Course, and Section 32 11 1601-Granular Sub-Base.

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-15.1-92, Calcium Chloride

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

1.5 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.
 - .1 Supply calcium chloride in quantities and at times as directed by Department representative.
 - .2 Deliver calcium chloride to site in moisture-proof bags. Indicate name of manufacturer, name of product, net weight or mass, and percentage of calcium chloride guaranteed by manufacturer.
- .3 Storage and Handling Requirements:
 - .1 Store bags of calcium chloride in weather-proof enclosures.
- .4 Packaging Waste Management: remove for reuse and return of pallets as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Calcium chloride, Type I: To CAN/CGSB-15.1, flake.
- .2 Water: in accordance with department representative's approval.

PART 3 EXECUTION

3.1 APPLICATION

- .1 Apply calcium chloride and water with equipment approved by department representative. at rate of 6.5 tonnes/km for flake when directed by department representative.
- .2 Apply water with distributors equipped with means of shut-off and with spray system to ensure uniform application.

3.2 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Place materials defined as hazardous or toxic in designated containers.

END OF SECTION

**SECTION 32 16 00
CURBS, GUTTERS AND SIDEWALKS**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 10 00 – Concrete Forming and Accessories
- .2 Section 03 20 00 – Concrete Reinforcing
- .3 Section 03 30 00 – Cast-in-Place Concrete
- .4 Section 31 05 16 – Aggregates for Earthwork
- .5 Section 31 23 33.01 – Excavating, Trenching and Backfilling

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 ABBREVIATIONS AND ACRONYMS

- .1 EPD: Environmental Product Declaration.
- .2 LCA: Life cycle assessment.
- .3 LCI: Life cycle inventory.
- .4 PCR: Product category rule.

1.4 DEFINITIONS

- .1 Environmental Product Declaration: Third-party verified documentation with the supporting product category rule and life cycle assessment information, including at least a cradle-to-gate scope. Prepared in accordance with ISO 14025, ISO 14040, ISO 14044, and EN 15804 or ISO 21930.
- .2 Industry-Average Environmental Product Declaration: Developed by an industry association and represents the average product of multiple companies. Products covered by Industry-Average Environmental Product Declarations are required to follow the same product category rule. Industry-Average Environmental Product Declarations cannot represent a certain manufacturer or its product. Industry-Average Environmental Product Declarations may be referred to as "industry-wide Environmental Product Declarations" or "generic Environmental Product Declarations."
- .3 Product-Specific Type III Environmental Product Declaration: Provides data on one product made by one manufacturer, but can involve multiple factories. Product-Specific Environmental Product Declarations can cover a product produced by a manufacturer in several plants throughout the world if all plants use the same processes. Product-Specific Environmental Product Declarations cannot represent several products or several manufacturers.

1.5 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO):
 - .1 AASHTO M 182-05, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

- .2 ASTM International (ASTM):
 - .1 ASTM C117-23, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
 - .2 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .3 ASTM C171-20, Standard Specification for Sheet Materials for Curing Concrete
 - .4 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - .5 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants
 - .6 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³ (600 kN-m/m³))
 - .7 ASTM D1751-23, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)
 - .8 ASTM D5893/D5893M-16, Standard Specification for Cold-Applied, Single-Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
- .3 CSA Group (CSA):
 - .1 CSA A23.1:19/A23.2:19, Concrete materials and methods of concrete construction/ Test Methods and Standard Practices for concrete
 - .2 CSA B651-18, Accessible design for the built environment

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Product literature and data sheets, including product characteristics, performance criteria, WHMIS SDSs, and limitations.
 - .1 Submit product data for:
 - .1 Concrete.
 - .2 Tactile warning indicators.
 - .3 Curing agent.
 - .4 Joint filler strips.
- .3 Sustainable Design Submittals: Information demonstrating sustainability characteristics specified in this Section and in accordance with Section 01 33 29 – Sustainable Design Reporting.
 - .1 Submit machine-readable EPDs or equivalent documents used to substantiate the carbon footprint of materials:
 - .1 in accordance with ISO 14025 Type III and ISO 21930; or
 - .2 generated by a software application validated as producing EPDs, compliant with ISO 14025 Type III and ISO 21930, and using input data produced from plant-specific, regional or Canadian industry-specific LCI data; or
 - .3 developed using similarly robust LCA methods in accordance with ISO 14040 and ISO 14044 or ISO 14067 and documented and validated by a third-party accredited professional in a letter of assurance.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

1.8 SITE CONDITIONS

- .1 Ambient 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/CSA A23.2.
 - .3 Cold Weather Protection:
 - .1 Maintain protection equipment in readiness on site.
 - .2 Use protection equipment when ambient temperature is below 5°C or when temperature may fall below 5°C before concrete has cured.
 - .4 Hot Weather Protection:
 - .1 Protect concrete from direct sunlight when ambient temperature is above 27°C.
 - .2 Prevent forms from getting too hot before concrete is placed. Apply accepted methods of cooling that will not negatively affect concrete.
 - .5 Protect concrete from drying.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Concrete Mixes and Materials: In accordance with Section 03 30 00 – Cast-in-Place Concrete
 - .1 Minimum strength: 32 MPa.
 - .2 Minimum size of aggregate: 19 mm.
- .2 Reinforcing Steel: In accordance with Section 03 20 00 – Concrete Reinforcing.
- .3 Granular Base and Backfill: Material to Section 31 05 16 – Aggregates for Earthwork and the following:
 - .1 Type 1, 2 or 3 fill.
 - .2 Crushed stone or gravel.
 - .3 Gradations: Within limits specified when tested to ASTM C136 and ASTM C117.
- .4 Non-Staining Mineral Type Form Release Agent: Chemically active release agents containing compounds reacting with free lime to provide water-soluble soap.
- .5 Joint Filler Strips:
 - .1 Contraction joint filler for curb and gutter: Hard-pressed fiberboard contraction joint filler.
 - .2 Expansion and control joint filler: To ASTM D1751, pre-moulded bituminous fibreboard.
- .6 Joint Sealants: Cold-applied joint sealant to ASTM C920.

- .7 Concrete Protection Materials: Linseed oil mixture, consisting of equal parts, by volume, linseed oil and either mineral spirits, naphtha, or turpentine.
- .8 Tactile Walking Surface Indicators: To CSA B651, cast iron, with truncated domes.
- .9 Form Work: Sidewalk forms and Curb and gutter forms in accordance with Section 03 10 00 – Concrete Forming and Accessories.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 – Examination and Preparation.

3.2 PREPARATION

- .1 Perform grade preparation work in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .2 Clean the underlying subgrade of all foreign substances before placing granular base.
- .3 Granular Base Preparation:
 - .1 Obtain department representative's review of subgrade before placing granular base.
 - .2 Place granular base material to lines, widths, and depths as indicated on the Drawings.
 - .1 Use base course materials equal in bearing capacity to the base under the adjacent pavement for curb and gutter.
 - .3 Compact granular base in maximum 150 mm layers to minimum 98% of maximum density to ASTM D698.
 - .4 Maintain granular base in smooth and compacted condition until the concrete is placed.
 - .1 Keep base course in a moist condition when concrete is placed.
 - .2 Protect base course from frost when concrete is poured.

3.3 APPLICATION

- .1 Form Setting:
 - .1 Prepare and construct formwork in accordance with Section 03 10 00 – Concrete Forming and Accessories.
 - .2 Set forms to the alignment, grade, and dimensions indicated on the Drawings.
 - .1 Verify grade and alignment of sidewalk forms with a 3 m straightedge. Allowable tolerance of 3 mm in any 3 m long section.
 - .2 Sidewalks transverse slope: As indicated on the Drawings (2%).
 - .3 Hold forms in place with a minimum of 3 stakes for each form, placed at intervals not exceeding 1.2 m.
 - .1 Use additional stakes and braces at corners, deep sections, and radius bends to provide rigidity in the forms.
 - .4 After completion of concrete placement:

- .1 For sidewalk, keep side forms in place for a minimum of 12 hours.
 - .2 Keep forms used along the front of the curb in place for a minimum of 2 hours and maximum of 6 hours.
 - .3 Keep forms used along the back of curb until the concrete finishing of the face and top of the curb are completed.
 - .4 Keep gutter forms in place while the concrete is sufficiently plastic to prevent slump in any direction.
- .2 Reinforcement Steel Placement:
 - .1 Fasten reinforcement steel in place with suitable supports and ties, and in accordance with Section 03 20 00 – Concrete Reinforcing.
- .3 Concrete Placement:
 - .1 Obtain department representative's review of granular base and reinforcing steel before placing concrete.
 - .2 Perform concrete work in accordance with Section 03 30 00 – Cast-in-Place Concrete.
 - .3 Place concrete in formed sidewalk in one layer.
 - .4 Consolidate and finish concrete to thickness indicated on the Drawings.
 - .5 Consolidate concrete by tamping and spading or with an acceptable vibrator.
 - .6 Immediately after floating, give sidewalk surface a uniform broom finish to produce regular corrugations not exceeding 2 mm depth, by drawing a broom side to side across sidewalk.
 - .7 Finish edges as indicated on the Drawings with 5 mm radius edging tool.
 - .1 Edge transverse joints before brooming.
 - .2 Round the edges of the gutter and top of the curb.
 - .3 Eliminate the flat surface left by the surface face of the edger with brooming.
 - .8 Finish curve shaped gutters with standard curb mule.
 - .9 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to department representative can be demonstrated. Hand-finish surfaces when directed by department representative.
 - .10 Maximum variations in finished surfaces: 6 mm from the measured edge of a 3 m straightedge.
- .4 Expansion and Contraction Joints:
 - .1 Construct tooled transverse contraction joints after floating, when concrete is stiff but still plastic, at intervals of 1.5 m. Construct longitudinal contraction joints along the centreline of all sidewalks 3 m or more in width.
 - .1 Cut a groove in the concrete surface to a minimum depth of 1/4 of sidewalk slab thickness.
 - .2 Construct expansion joints at intervals of 6 m.
 - .1 Form expansion joints using 13 mm joint filler strips.
 - .2 Hold joint filler in place with steel pins to prevent warping of the filler during floating and finishing.

- .3 Round joint edges using an edging tool having a radius of 5 mm after finishing is completed. Remove any concrete over the joint filler.
 - .4 Clean the top of expansion joints and fill with cold-applied joint sealant at the end of curing time.
 - .5 When sidewalk is adjacent to curb, make the joints in curb, gutter, and sidewalk coincide.
- .5 Isolation Joints:
 - .1 Install isolation joints around manholes, catch basins, and along the length adjacent to concrete curbs, buildings, or permanent structures.
 - .2 Install joint filler in isolation joints in accordance with Section 03 30 00 – Cast-in-Place Concrete.
 - .3 Seal isolation joints with reviewed sealant.
- .6 Tactile Walking Surface Indicators:
 - .1 Install tactile walking surface indicators at curb ramp edges, where indicated on the Drawings, in accordance with CSA B651, and local municipal bylaws.
 - .2 Maximum height of the base surface carrying the tactile walking surface indicator: 3 mm above adjacent paving.
- .7 Curing:
 - .1 Cure concrete by adding moisture continuously in accordance with CSA A23.1/A23.2 to exposed finished surfaces for minimum 7 days after placing, or seal moisture in using curing compound reviewed by department representative.
 - .2 Protect unhardened concrete from rain and flowing water.
 - .3 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period. Overlap mats minimum 150 mm.
 - .4 Where impervious sheeting material is used, wet the entire exposed surface with a fine spray of water and then cover with sheeting.
 - .1 Place the sheets directly on the concrete surface with the light-coloured side facing upward. Overlap sheets minimum 300 mm.
 - .2 Sheeting width: 450 mm wider than the concrete surface.
 - .3 Secure sheeting and replace torn or damaged sheets.
 - .5 Where membrane is used, apply a uniform coating of white-pigmented membrane-curing compound to the entire exposed surface of the concrete as soon as the free water has evaporated from the finished surface.
 - .1 Coat formed surfaces immediately after removing forms and a maximum of 1 hour after the removal of forms.
 - .2 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.
 - .3 Respray concrete surfaces that are subjected to heavy rainfall within 3 hours of curing compound application.
- .8 Backfill:
 - .1 Allow concrete to cure for 7 days prior to backfilling.

- .2 Backfill to designated elevations with fill material in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
 - .1 Compact and shape to contours as indicated on the Drawings.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning.
- .2 Waste Management:
 - .1 Manage waste in accordance with Section 01 74 19 – Waste Management and Disposal.
- .3 Divert unused concrete materials from landfill to local pit.

END OF SECTION

1 GENERAL

1.1 WORK INCLUDED IN THIS SECTION

1.1.1 This Section includes furnishing and installing chain link fencing for security purpose consisting of but not limited to the following:

1.1.1.1. Galvanized or aluminum-coated-steel chain link fabric.

1.1.1.2. Galvanized-steel framework.

1.1.1.3. Chain Link Sliding Gate. Refer to Section 11 20 00 for Gate Operator.

1.2 SUBMITTALS

1.2.1 General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

1.2.2 Product Data: Submit manufacturer's technical specifications and installation instructions for fence and gate posts fabric, gates, gate operators and accessories.

1.2.3 Shop Drawings: Show location of fence, gates and each post, and details of post installation. Include details of footings, gates, posts, rails, frames, post tops, tension wires, bands and bars, bracing, ties, clips, spacing, installation and complete interfacing with locks and all other components. Provide specific elevations of all locations with grade changes. Indicate all additional bracing, supports and connection details to meet fence performance criteria.

1.2.4 Welder Certification: Submit certificates signed by Contractor certifying that welders comply with requirements specified under the 'Quality Assurance' Article.

1.2.5 Qualification Data: Submit for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project name, addresses, names of Architects and owners and other information specified.

1.3 QUALITY ASSURANCE

1.3.1 Installer Qualifications: Engage an experienced installer who has at least five years experience and has completed at least five chain link fence projects of similar scope as indicated for this project with a successful construction record of in-service performance.

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- 1.3.2 Welder qualifications:
- 1.3.2.1. Employ only welders certified under CSA W47.1-92 Classification 2.1; or AWS D1.1 or B2.1 certified within past 12 months and qualified for AWS D1.3 and D9.1 welding processes.
- 1.3.2.2 Single-Source Responsibility: Obtain chain link fences and gates including accessories, fittings and fastenings from a single source.
- 1.3.3 Fence Grounding Installer Qualifications: Engage an experienced UL or ULC listed installer of UL96A Master Label lightning protection systems or equivalent under CAN/CSA-B72-M87(R1992). (The fence grounding will not, however require a Master Label).
- 1.4 **PROJECT CONDITIONS**
- 1.4.1 Field Measurements: Verify layout information for Fencing shown on the Drawings. Verify dimensions by field measurements.
- 1.5 **DELIVERY, STORAGE AND HANDLING**
- 1.5.1 Deliver material to the site in undamaged condition. Carefully store material off the ground to provide proper protection against oxidation.
- 1.5.2 When handling material, care shall be taken not to damage framing or fabric in any way. Damaged material including, but not limited to deformed fabric will be rejected and shall be removed from the site.
2. **PRODUCTS**
- 2.1 **MANUFACTURERS**
- 2.1.1 Subject to compliance with requirements provide products by one of the following or equal.
- Amico Canada, Inc., Mississauga, Ontario
Atlas Fence, Toronto, Ontario
M & G Fencing Inc. Azilda, Ontario
- 2.2 **FABRIC**
- 2.2.1 Steel Chain-Link Fence Fabric: Fabricated to comply with Chain Link Fence manufactures Institute (CLFMI) "Product Manual" and with requirements indicated below:
- 2.2.1.1. Mesh and Wire Size: 50 mm mesh, 3.76 mm. (9 ga.)

2.2.1.2. Coating: One of the following:

- .1 ASTM A 817, Type I, aluminized.
- .2 ASTM A 817, Type II, Class 2, zinc-coated (galvanized).

2.2.1.3. All chain link to be black vinyl covered.

2.3 **FRAMING**

2.3.1 Round member sizes are given in actual outside diameter (OD) to the nearest thousandth of inches. Round fence posts and rails are often referred to in ASTM standard specifications by nominal pipe sizes (NPS) of the equivalent trade sizes in inches. The following indicates these equivalents:

<u>Actual OD</u> mm	<u>NPS Size</u>	<u>Trade Size</u>
42.2	1-1/4	1-5/8
48.3	1-1/2	2
60.3	2	2-1/2
73.0	2-1/2	3
88.9	3	3-1/2
101.6	3-1/2	4
168.3	6	6-5/8
219.1	8	8-5/8

2.3.2 Type I Round Pipe: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1043, Group 1A heavy industrial requirements and minimum yield strength of 170 MPa according to ASTM F 1083; and conforming to ASTM F 1043 Type A coating inside and outside with not less than 550 g/m² zinc as determined by ASTM A90 ; and weights per foot as follows:

<u>Actual OD</u> mm	<u>Weight</u> kg/m	<u>NPS Size</u>
42.2	3.4	1-1/4
48.3	4.0	1-1/2
60.3	5.4	2
73.0	8.6	2-1/2
88.9	11.3	3
101.6	13.6	3-1/2
168.3	28.3	6
219.1	42.5	8

2.3.3 Type II Round Pipe: Cold-formed, electric-welded steel pipe conforming to heavy industrial requirements of ASTM F 1043, Group IC, with minimum yield strength of 345 MPa, with protective coating system below according to ASTM

F 1234 and
weights per foot as follows:

- 2.3.3.1. Coatings: Conforming to ASTM F 1043, Outside, Type B with minimum 280 g/m² zinc after welding, a chromate conversion coating and clear polymer overcoat. Inside Type D, nominal 81% zinc pigmented coating, 0.0076 mm minimum thick or, Type B with a minimum of 280 g/m².

<u>Actual OD</u> mm	<u>Weight</u> kg/m	<u>NPS Size</u>
42.2	2.72	1-1/4
48.3	3.37	1-1/2
60.3	4.62	2
73.0	6.88	2-1/2
88.9	8.45	3
101.6	9.76	3-1/2

- 2.3.4 Rails (Top, Intermediate, Bottom and Brace Rails): Manufacturer's longest lengths
5.2 to 6.4 m with expansion-type rail sleeve coupling. Provide intermediate bottom and brace rails continuous between posts.

- 2.3.4.1. Round Steel: 42.2 mm OD Type I or II steel pipe.

- 2.3.5 Fence Posts (Type I or II unless noted otherwise):

<u>Fence Top</u> <u>Fabric Height</u>	<u>Line or Intermediate Post</u> <u>Diameter</u>	<u>End, Corner, Isolation and</u> <u>Pull Post Diameter</u>
Up to 2.4 m	60.3 mm	73.0 mm

- 2.3.6 Swing Gate Posts: Provide steel pipe gate posts sized as follows of either Type I or Type II round pipe unless otherwise indicated. Comply with ASTM F 900. Furnish gate posts as indicated below to support a single gate leaf or one leaf of a double- gate installation. Where also serving as a fence end post provide greater of sizes indicated for gate or end-posts.

<u>Gate Leaf Width</u>	<u>Gate Post Diameter</u>
Up to 1.8 m	73.0 mm
Over 1.8 m to 3.7 m	101.6 mm Type I only
Over 3.7 to 5.5 m	168.3 mm Type I only
Over 5.5 to 7.3 m	219.1 mm Type I only

- 2.3.7 Gate Framework: Provide steel pipe gate frame members sized as follows of either Type I or Type II round pipe unless otherwise indicated. Comply with ASTM F900 for swing gates and ASTM F1184 Type I for overhead slide gates.

Gate Top
Fabric Height
Up to 3.7 m

Swing Gate Frame
Pipe Diameter
48.3 mm

2.4 **FITTINGS AND ACCESSORIES**

- 2.4.1 Material: Comply with ASTM F 626; galvanized iron or steel to suit manufacturer's standards. Unless specified otherwise, hot-dip galvanized pressed steel or cast iron fence fittings and accessories shall be coated with minimum 370 g/m² zinc as determined by ASTM A90 or CAN/CSA-G164-M92.
- 2.4.2 Post Caps: Provide tight press-fit weather tight closure cap for each post not capped with a barb arm.
- 2.4.3 Rail and Brace Ends: Provide manufacturer's standard galvanized-steel or cast iron rail ends with 8 x 38 mm carriage bolts or line rail clamp (boulevard) connectors with 10 mm bolts.
- 2.4.4 Top Rail Sleeves: Provide manufacturer's standard pressed steel or round steel tubing galvanized sleeve, 150 mm long minimum.
- 2.4.5 Tie Wires, Clips and Fasteners: Provide tie wires and clips(hog rings) of 3.8 mm diameter galvanized steel with a minimum of 250 g/m² of zinc coating according to ASTM A 641, Class 3. Where indicated, provide power driven wire/fabric fasteners complying with ASTM F626 and as follows: Security Fabricators, Inc., Sure-Loc.
- 2.4.6 Tension and Brace Bands: 19 mm wide by 2.7 mm thick minimum hot-dip galvanized steel with a minimum of 365 g/m² of zinc coating per sq. ft.
- 2.4.7 Tension (Stretcher) Bars: Hot -dip galvanized steel with a minimum length 50 mm less than the full height of fabric, a minimum cross section of 5 by 19 mm and a minimum of 365g/m² of zinc coating. Provide one bar for each gate and end post, and two for each corner and pull post.
- 2.4.8 Truss Rod Assembly: 10 mm diameter truss rod with turnbuckle or other adjustable tightener. Provide manufacturer's standard truss rod connections to brace rail end at line post and to brace band at terminal post.
- 2.4.9 Post Top Arms: Costumed fabricated galvanized structural steel angle arms, with hole for passage of top rail and with provision for anchorage to posts and attachment of tension wire to each arm. Weld to post. Provide special corner posts arms with matching features. Provide following type:
- 2.4.9.1. Single 45-degree arm for two rows of tension wire, one arm for each post.

2.5 TENSION WIRE

2.5.1 Tension Wire: 4.5 mm diameter metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric; galvanized as follows:

2.5.1.1. Coating Type II zinc in the following class as determined by ASTM A90.
Class 3, with a minimum coating weight of 610 g/m² of uncoated wire surface.

2.6 PERSON GATES

2.6.1 Assemble specified gate framing by welding. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware and accessories. Space frame members maximum of 2.4 m apart unless otherwise indicated.

2.6.1.1. Fabric: Same as for fence unless otherwise indicated. Secure fabric at vertical edges with tension bars and bands; and to top, bottom and intermediate framing with tie wires.

2.6.1.2. Bracing: Install diagonal cross-bracing consisting of 10 mm diameter adjustable- length truss rods on gates to ensure frame rigidity without sag or twist.

2.6.1.3. Gate Top:

1. Extend vertical members of gate above top horizontal frame member and provide brace bands to secure wire to extended verticals for the following where indicated:
2. Horizontally offset welded gate top framing to prevent gate top interference with adjacent fence top as gate opens.

2.6.1.4. Security Hardware Preparations: Drill, cut, offset, add galvanized weldments and otherwise modify gate and fence framing as indicated or, if not indicated, as required to receive hardware specified in Division 08.

2.6.2 Pedestrian Swing Gates: Comply with ASTM F900, except as otherwise indicated.

2.6.2.1. Swing Gate Hardware – for Pedestrian Gate: Provide swing gates with ASTM A153 hot dip galvanized hardware as follows:

<u>Gate Top Fabric Height</u>	<u>Hinges per Gate Leaf</u>	<u>Padlock Gates Only</u> <u>Drop Rod</u> <u>Guides</u>
Up to 2.1 mm	2	2

1. Hinges: Industrial hinge combination (malleable) cast iron, ball and socket, non-lift-off type with offset adapter for 180° swing. Pressed steel is not acceptable.
2. Padlock, Lock Preparations: Enable a single lock to secure an opening, Padlocks: Locate padlock eyes at waist height for padlocking. Padlocks provided by Client.

2.7 **SLIDING GATE**

- .1 Chain link fencing gate with black vinyl to match fencing.
- .2 Dimensions: 1.8m high x 7m clear opening. Site verify.
- .3 Gate operator per Section 11 12 00.
- .4 Guides:
 - .1 Welded structural gate posts with guide wheels and running wheels.
 - .2 Galvanized after fabrication to ASTM 123M
 - .3 60mm x 80mm x 1.8m support posts, connected at the top, form rigid frames to support the gate. Flanged for securing to foundation or set in concrete foundation.
 - .4 Sealed bearing, nylon polyamide 160mm [6 5/16"] maintenance free, enclosed roller sets.
 - .5 Catch post with run-on plate for secure closure.
 - .6 Gate support posts feature integral mount for gate operator, ensuring correct alignment for the life of the system.
 - .7 Fasteners: Concealed, stainless steel.

2.8 **GALVANIZING REPAIR PAINT**

- 2.8.1 Galvanizing Repair Paint: Provide one of the following:

<u>Manufacturer</u>	<u>Product</u>
Sherwin-Williams	Zinc Clad IV A Two Package Zinc Rich Epoxy Primer B69A8/B69V8
Southern Coatings	Chemtec 600 Hi Ratio Inorganic Zinc Rich Primer 1-4713.
Tnemec	Tnemec-Zinc, Zinc Rich Primer 90-97
Valspar	MZ-6 Hi Ratio Inorganic Zinc Rich 13-F-6

2.9 **CONCRETE AND REINFORCEMENT**

- 2.9.1 Concrete: CAN/CSA A23.1/A23.2-M90. Provide concrete consisting of Portland cement per ASTM C 150, aggregates per ASTM C33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 21 Mpa. Use at least four sacks of cement per m³, 25 mm maximum size aggregate; 75 mm maximum slump.
- 2.9.2 Packaged Concrete Mix: Mix dry-packaged normal-weight concrete conforming

to ASTM C 387 with clean water to obtain a 50 to 75 mm slump.

- 2.9.3 Reinforcement: Where indicated, provide deformed billet steel reinforcing bars meeting ASTM A615, Grade 60 or CAN/CSA-G30.18-M92.

3. EXECUTION

3.1 FENCE INSTALLATION

- 3.1.1 General: Install fence to comply with ASTM F 567. Erect fencing in straight lines between terminal posts (corner, end, gate, isolation, pull, or wall posts). Do not begin installation before final grading is complete, unless authorized in writing by Consultant.

3.1.1.1. Post Locations:

1. Line Posts: Provide equally spaced up to 2.4 m o.c. unless otherwise indicated.
2. Pull Posts: Provide, braced both ways, at abrupt changes in grade (15 degrees or more) and evenly spaced at intervals not exceeding 150 m between other terminal posts.
3. Corner Posts: Provide braced both ways, at changes in direction of 15 degrees or more.
4. End and Gate Posts: Provide at locations indicated and, where not indicated, as required. Provide bracing.

3.1.2 Tolerances

- 3.1.2.1. Post Deflection: Install all posts including line, end, gate, corner, pull and isolation posts to deflect, with full recovery, no more than 19 mm when a 220 Newtons load is applied to a post perpendicular to the fence fabric face at 1.5 m above grade.

- 3.1.2.2. Fence Fabric Deflection: Install and tension fence fabric, including horizontal and vertical applications, to defect, with full recovery, no more than 50 mm when a 130 Newtons load is applied to a fabric panel centered between framing members and perpendicular to the fence fabric face.

3.1.3 Excavation:

3.1.3.1. General:

1. Satisfactory Soils: Excavate as indicated below.
2. Unsatisfactory Soils: Notify Consultant where encountered. Where specifically authorized in writing by Town of Brant Representative, modify footing and excavation for adjustment as a change in accordance with Conditions of the Contract.

- 3.1.3.2. Post Holes: Hand excavate (using post-hole digger) or drill holes for posts to diameters and depths indicated.

Excavated Earth

<u>Fence Top</u> <u>Fabric Height</u>	<u>Post Bottom</u>	<u>Hole Depth</u>
1.8 or less	840	915
2.1	990	1070

Double-post hole diameters indicated below are for isolation posts sharing a common footing with an adjacent gate or other post. Drill separate holes in rock or concrete.

<u>Single Or</u> <u>Largest Post</u> <u>Outside</u> <u>Diameter (OD)</u> mm	<u>Excavated</u> <u>Earth</u> <u>Single Post</u> <u>Hole Diameter</u> mm	<u>Cored</u> <u>Rock/Concrete</u> <u>Double Post</u> <u>Hole Diameter</u> mm	<u>Hole Diameter</u> mm	<u>Post Bottom/</u> <u>Hole Depth</u> mm
60.3	255	---	75	180
73.0	305	460	90	230
88.9	355	510	100	280
101.6	405	610	115	305
168.3	610	915	205	510
219.1	915	1220	255	660

- 3.1.4 Concrete Placement and Posting Setting:

- 3.1.4.1. Posts Setting in Holes: Center and align posts in holes with post bottom depth as indicated above.

- Concrete for Excavated Earth Post Holes: Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations. Unless otherwise indicated, extend concrete post footings 50 mm above grade and trowel to a crown to shed water.

- 3.1.4.2. Post Setting on Base Plate: Where indicated or required, provide base plate as specified corresponding to post diameter. Center post and weld all around to base plate. Provide anchor bolts in diameters specified with length and types indicated or required.

-
- 3.1.4.3. Miscellaneous Concrete Footings: Provide concrete for gate stops, gate keepers, and other items as indicated or required. Place reinforcement at locations indicated, tied secure in position using support devices to prevent displacement. Place concrete and vibrate or tamp for consolidation.
- 3.1.4.4 Post Caps and Post Top Arms: Place on post immediately at post setting to prevent accumulation of rainwater in posts. Before completion, tack weld or screw fasten each post top arm to post as specified at side opposite fabric.
- 3.1.5.1. Where terminal posts rise above line post top arm height, provide side-mount arm welded or brace band attached to terminal post.
- 3.1.5.2. Install post top arms at terminal posts, including corner posts, with blade length and angle to maintain tips aligned vertically and horizontally with adjacent line post top arm tips.
- 3.1.6 Rails (Intermediate, Bottom, and Brace Rails):
- 3.1.6.1. Intermediate and Bottom Rails: Install intermediate and bottom rails in one piece between posts and flush with post on fabric side, using rail ends and special offset fittings where necessary.
- 3.1.6.2. Brace Assemblies: Install braces at end, isolation, and gate posts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric on fences with top rail and at two thirds fabric height on fences without rail, unless otherwise indicated. Install so posts are plumb when diagonal truss rod is under proper tension at no more than 50 degree angle from grade.
- 3.1.7 Tension Wire:
- 3.1.7.1. Fence Fabric Support: Pull tension wire taut, without sags, before stretching fence fabric. Tie tightly to each post, post cap, or barb arm with metal straps or wire of not less than same gauge and type. Allow no slack around wire.
1. Bottom Tension Wire: Install within 150 mm of fence fabric bottom.
 2. Top Tension Wire: Install 50 mm from fence fabric top, through post cap or barb arm loop holes.
- 3.1.8 Fence Fabric: **Install fence fabric upside down/reversed as per Client requirements.** Handle, supporting and bracing as required, to prevent deformation or other damage to chain links. Provide 3 full twists (1-1/2 machine turns) at field cut selvages. Secure to framework as follows:
- 3.1.8.1. Tension (Stretcher) Bars: Thread through full height uncut fabric end picket and secure to end, gate, corner, isolation or pull post with tension bands spaced not over 330 mm o.c. Tighten as required to meet deflection tolerance for fence fabric as specified.
- 3.1.8.2. Clips (Hog Rings): Fasten tight, without slack, at 600 mm o.c. to top or bottom

tension wire.

- 3.1.8.3. Tie Wires: Tie through fabric and around frame member engaging at least one strand of each fabric piece. Align twist with fabric on framework side of fabric. Twist pulling fabric in close contact with frame member and forcing tie wire to conform tightly to frame member shape. Twist both tie wire ends 3 full twists (1-1/2 machine turns). Cut off excess wire to prevent hand untwisting.

1. Line Posts: Tie wires at 300 mm o.c.
2. Fence Rails: Tie wires at 600 mm o.c.
3. Gate Rails: Tie wires at 300 mm o.c.
4. Parallel Fabric Pieces Lapped on a Frame Member: Tie wires at 300 mm o.c.

- 3.1.8.4 Power Driven Fasteners: Provide where indicated and at Contractor's option at locations indicated for tie wires above.

3.2 **GATE INSTALLATION**

- 3.2.1 Install gates plumb, level and secure for full opening without interference. Adjust hardware for smooth operation and lubricate. Install gates according to manufacturer's instructions, with no more than 75 mm clearance under closed gate.

- 3.2.2 Hardware: Install padlock hasps, hinges etc. as per manufacturer's recommendations, and reviewed and accepted shop drawings. Adjust and properly lubricate hardware to provide smooth, consistent trouble-free operation.

3.3 **ADJUSTING AND CLEANING**

- 3.3.1 Debris Control: Take extreme care to ensure that scrap materials generated during installation (including, wire ties, clips, fabric trimmings and other debris) are disposed of properly. Inspect fence and ground in the work area and removal all loose items from the site at the end of each work day and upon completion.

- 3.3.2 Galvanizing Touchup: Immediately upon delivery at job site and continuously during construction, sand and clean any rust, abrasions, scratches, or field fabrication and welding damage to galvanized surfaces. At affected areas apply 0.15 mm min. galvanizing repair paint in 3 coats of 0.05 mm min. each.

END OF SECTION

**SECTION 32 91 19.13
TOPSOIL PLACEMENT AND GRADING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 11 00 - Clearing and Grubbing
- .2 Section 31 14 13 - Soil Stripping and Stockpiling

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 Agriculture and Agri-Food Canada (AAFC):
 - .1 The Canadian System of Soil Classification 3rd edition, 1998
- .2 ASTM International (ASTM):
 - .1 ASTM C602-23, Standard Specification for Agricultural Liming Materials
 - .2 ASTM D5268-23, Standard Specification for Topsoil Used for Landscaping and Construction Purposes
- .3 Canadian Council of Ministers of the Environment (CCME):
 - .1 PN 1340-2005, Guidelines for Compost Quality
- .4 Canadian Society of Landscape Architects (CSLA) & Canadian Nursery Landscape Association (CNLA):
 - .1 Canadian Landscape Standard, Second Edition

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the department representative and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review substrate conditions.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets including product characteristics, performance criteria, WHMIS SDSs, and limitations.
- .3 Manufacturer's instructions:

- .1 Special delivery, storage, and handling requirements.
- .2 Application instructions.
- .3 Recommended sequencing.
- .4 Cleaning procedures.
- .4 Source quality control submittals:
 - .1 Comply with the requirements of Section 01 45 00 - Quality Control.
 - .2 Compost tests and analysis: In accordance with the Compost Quality Alliance (CQA).

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Landscaper: Member in good standing of Landscape Ontario Green for Life (LO).
 - .2 Landscape supervisor: Landscape horticulturist journey person or certified landscape horticulturist technician with softscape installation designation or equivalent.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Storage and handling requirements:
 - .1 Handle materials only when in a dry and unfrozen state.

1.8 SITE CONDITIONS

- .1 Ambient conditions:
 - .1 Do not disturb wet or frozen soil with 27% (or higher) clay content.

PART 2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Topsoil and soil amendments to provide suitable medium for supporting intended plant growth:
 - .1 pH range: 6.5 to 8.0.
 - .2 Provide materials without toxic or growth-inhibiting contaminants.
 - .3 Fertilizer:
 - .1 Major soil nutrient concentrations per gram of topsoil:
 - .1 Nitrogen (N): 20 µg to 40 µg.
 - .2 Phosphorus (P): 40 µg to 50 µg.
 - .3 Potassium (K): 75 µg to 110 µg.
 - .2 Provide calcium (C), magnesium (Mg), sulphur (S), and other micro-nutrients in balanced ratios to support germination and establishment of intended vegetation.

2.2 TOPSOIL

- .1 Topsoil for seeded areas and sodded areas: Mixture of particulates, micro-organisms, and organic matter.
 - .1 Consistency: Friable when moist.
- .2 Topsoil for seeded or sodded areas:
 - .1 Natural or manufactured.
 - .2 Rich in organic matter (humus) and mineral elements.
 - .3 Screened, free of unwanted large particles such as roots, gravel, and rocks.

2.3 SOIL AMENDMENTS

- .1 Fertilizers: Industry-accepted mediums containing nitrogen, phosphorus, potassium, and other micro-nutrients suitable to specific plant species or application, or as recommended based on soil test results.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Before stripping topsoil, verify areas affected by work of this section have been cleared of items indicated in Section 31 11 00 - Clearing and Grubbing.
 - .2 Verify subgrades are correct and sloped as indicated on the Drawings.

3.2 TOPSOIL STRIPPING

- .1 Strip topsoil in accordance with Section 31 14 13 - Soil Stripping and Stockpiling.

3.3 PREPARATION

- .1 Surface preparation:
 - .1 Clear surface in accordance with Section 31 11 00 - Clearing and Grubbing.
 - .2 Cultivate entire area to receive topsoil to minimum 150 mm deep.
 - .1 Cross cultivate areas where equipment used for hauling and spreading has compacted soil. Cultivate compacted areas to minimum 150 mm deep.

3.4 PLACING AND SPREADING TOPSOIL

- .1 Place topsoil after the department representative has reviewed the prepared subgrade.
- .2 Spread topsoil during dry conditions in uniform layers not exceeding 150 mm, over unfrozen subgrade free of standing water.
- .3 Spread topsoil as indicated on Drawings to the following minimum depths after settlement:
 - .1 Seeded areas: 150 mm.
 - .2 Sodded areas: 150 mm.
 - .1 Keep topsoil 15 mm below finished grade for sodded areas.

- .4 Manually spread topsoil/planting soil around trees, shrubs, and obstacles.
- .5 Establish traffic patterns for equipment to prevent driving on topsoil after it has been spread to avoid compaction.
- .6 After spreading procedures are complete, cultivate soil.

3.5 SOIL AMENDMENTS (NOT USED)

3.6 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas to provide positive drainage.
 - .1 Slope grades: Minimum 2% away from buildings.
 - .2 Prepare loose, friable beds by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density.
 - .1 Leave surfaces smooth, uniform, and firm against deep foot printing.
- .3 Finish graded surfaces to be free of:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Coarse vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.
- .3 Dispose of surplus materials off site, including topsoil.

END OF SECTION

**SECTION 32 92 23
SODDING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 32 19.16 - Geotextile Soil Stabilization
- .2 Section 32 91 19.13 - Topsoil Placement and Grading

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 Agriculture and Agri-Food Canada (AAFC):
 - .1 R.S.C., 1985, c. F-10, Fertilizers Act
- .2 Canadian Society of Landscape Architects (CSLA) & Canadian Nursery Landscape Association (CNLA):
 - .1 Canadian Landscape Standard (CLS) -Second Edition, Version 4 (2024)
- .3 Canadian Nursery Landscape Association (CNLA):
 - .1 Canadian Nursery Stock Standard (CNSS), ninth edition

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for sods, geotextile fabrics, and fertilizers, including product characteristics, performance criteria, physical sizes, WHMIS SDSs, and limitations.
- .3 Certificates: Certifying the quality, species, grade, and location of sod source, verifying compliance with the CLS and CNSS, and signed by the supplier.
- .4 Manufacturer's instructions: For geotextile fabrics.
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Recommended sequencing.
- .5 Special procedure submittals:
 - .1 Sodding schedule, including:
 - .1 Quantities and types of sod.
 - .2 Shipping dates.
 - .3 Delivery dates.
 - .4 Preparation of soil dates.
 - .5 Sod placement dates to coincide with topsoil preparation.

- .2 Request written notice of acceptability of schedule from the department representative, minimum 5 Working Days before shipping plant material.
- .6 Qualification statements:
 - .1 Submit proof of specified qualifications when requested by the department representative.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Maintenance contracts:
 - .1 Include in the unit price, maintenance of sodded areas during establishment period, from time of sodding, for 6 weeks.
 - .2 Include in the unit price, maintenance of sodded areas, from time of sodding until substantial completion.
 - .3 Submit a maintenance contract, as specified in MAINTENANCE in this section, from time of Substantial Completion through warranty period, and executed by authorized company official.
- .3 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, a comprehensive sod maintenance log book. Log book to include at a minimum:
 - .1 Fertilization program.
 - .2 Watering schedule.
 - .3 Weed removal by mechanical or chemical means.
 - .4 Cutting schedule.
 - .5 Other recommended maintenance to be performed and notable site-specific procedures and products.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Landscapers: Member in good standing of Landscape Ontario (LO).
 - .2 Landscape sodding supervisor: Landscape horticulturist journeyman or certified landscape horticulturist technician with softscape installation designation or equivalent.
 - .3 Landscape maintenance supervisor: Landscape horticulturist journeyman or certified landscape horticulturist technician with turf maintenance designation or equivalent.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
- .2 Palletized sod products:
 - .1 Provide wind protection to prevent drying during transportation and delay in installation.
 - .2 Verify sod is fresh and healthy when it arrives on site.
 - .3 Do not dump or drop sod from vehicle.

- .4 During growing season deliver sod to site within 36 hours of harvest.
- .5 If sod becomes waterlogged, allow sod to dry sufficiently to prevent tearing or damage during handling.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Number one turf grass nursery sod: Sown and cultivated in nursery as turf grass crop, with established fibrous root system, free from stones and burned or bare spots.
 - .1 Turf grass nursery sod types:
 - .1 Number one Kentucky bluegrass sod: Nursery sod grown solely from seed of cultivars of Kentucky bluegrass.
 - .1 Containing minimum of 50% Kentucky bluegrass cultivars.
 - .2 Number one named cultivars: Nursery sod grown from certified seed.
 - .2 Turf grass nursery sod quality: To the CLS and CNSS.
 - .1 Maximum one broadleaf weed and up to 1% native grasses per 40 m².
 - .2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
 - .3 Mowing height limit: 35 to 65 mm.
 - .4 Soil portion of sod: 6 to 15 mm thick.
- .2 Water:
 - .1 Provide water from local source or from trucked-in source as required during maintenance period and until sod is established.
 - .2 Free of impurities that would inhibit plant growth.
- .3 Fertilizer:
 - .1 To R.S.C., 1985, c. F-10 and its Regulations.
 - .2 Complete, commercial, slow release with 65% of water-insoluble nitrogen content.
- .4 Erosion control mesh/netting.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify soil substrates and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Grades are correct and prepared in accordance with Section 32 91 19.13 - Topsoil Placement and Grading.
 - .2 Do not perform work under adverse site conditions such as frozen soil, excessively wet soil, soil covered with snow, ice, or standing water.

3.2 PREPARATION

- .1 Fine grade surface free of humps and hollows to smooth, even grade, to contours and elevations indicated on Drawings, to tolerance of ± 8 mm, for turf grass nursery sod and ± 15 mm for commercial grade turf grass nursery sod, surface to drain naturally.

- .2 Remove and dispose of weeds, debris, stones 20 mm in diameter and larger, soil contaminated by oil, gasoline and other deleterious materials off-site, in accordance with Section 01 74 19 - Waste Management and Disposal.

3.3 SOD PLACEMENT

- .1 Lay sod during active growing season for type of sod.
- .2 Lay sod within 24 hours of being delivered.
- .3 Lightly moisten dry growing medium surfaces immediately before laying sod.
- .4 Lay sod flush with adjoining grass areas, paving, and top surface of curbs, unless indicated otherwise on Drawings.
- .5 Lay sod sections in rows, joints staggered a minimum of 250 mm. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .6 Roll sod to obtain close contact between sod and soil using light rolling; use of heavy rolling to correct irregularities in grade is not permitted.

3.4 SOD PLACEMENT ON SLOPES AND PEGGING

- .1 Install and secure geotextile fabric in areas indicated on Drawings, in accordance with manufacturer's instructions.
- .2 Install erosion control mesh/netting in sodded areas where required, and secure with stakes or staples set to a minimum depth of 150 mm.
- .3 Start laying sod at bottom of slopes.
- .4 Peg sod on slopes steeper than 3:1 within 1 m of catch basins, drainage channels, and ditches to the following pattern:
 - .1 100 mm below top edge at 200 mm on-centre for first sod sections along contours of slopes.
 - .2 Not less than three pegs per m².
 - .3 Not less than six pegs per m² in drainage structures.
 - .4 Drive pegs to 20 mm above soil surface of sod sections.

3.5 SITE QUALITY CONTROL

- .1 Conforming work:
 - .1 Following the time of sodding through Substantial Completion, turf grass nursery sod areas to be considered conforming when:
 - .1 sodded areas are properly established;
 - .2 no bare or dead spots in sodded areas;
 - .3 no visible surface soil from a height of 1500 mm when sod has been cut to height of 60 mm;
 - .4 sodded areas are 95% weed free;
 - .5 fertilizing program has been performed and logged minimum two times; and
 - .6 areas sodded in the fall will be reviewed for conformance the following spring, 1 month after start of growing season, provided conforming work conditions are fulfilled.

- .2 At the end of the warranty period turf grass nursery sod areas to be considered conforming when:
 - .1 no bare or dead spots in sodded areas;
 - .2 no visible surface soil from a height of 1500 mm when sod has been cut to height of 60 mm;
 - .3 sodded areas are 95% weed free; and

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning, and:
 - .1 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal, and:
 - .1 Remove recycling and compost containers and bins from site and dispose of materials at appropriate facility.
 - .2 Divert unused fertilizer from landfill to official hazardous material collections site.
 - .3 Return pallets to sod nursery.

3.7 PROTECTION

- .1 Protect newly sodded areas from vehicular and foot traffic with snow fence on rigid frame.
- .2 Remove protection after sod is established.

3.8 MAINTENANCE

- .1 During establishment period and until Substantial Completion:
 - .1 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 100 mm.
 - .1 Record quantity of water applied in log book.
 - .2 Maintain sodded areas minimum 95% weed free.
 - .3 When environmental conditions allow, top-dress and seed all sodded areas showing shrinkage cracks with seed mix, matching the original.
- .2 During warranty period:
 - .1 Water sodded areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.
 - .2 Repair and resod dead or bare spots.
 - .3 Cut grass at 2-week intervals so approximately one third of growth is removed in a single cut.
 - .4 Eliminate weeds by mechanical or chemical means.

END OF SECTION

**SECTION 32 92 19.16
HYDRAULIC SEEDING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS (NOT USED)

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 Agriculture and Agri-Food Canada (AAFC):
 - .1 C.R.C., c. 1400, Seeds Regulations
 - .2 R.S.C., 1985, c. F-10, Fertilizers Act
 - .3 R.S.C., 1985, c. S 8, Seeds Act
- .2 Canadian Nursery Landscape Association (CNLA):
 - .1 Canadian Nursery Stock Standard, ninth edition
- .3 Canadian Society of Landscape Architects / Canadian Nursery Landscape Association (CSLA/CNLA):
 - .1 Canadian Landscape Standard (CLS), second edition

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings and attended by the department representative and appropriate Subcontractors to:
 - .1 Verify project requirements.
 - .2 Review delivery, storage, and handling requirements.
 - .3 Review installation and substrate conditions.
 - .4 Coordinate with other Subcontractors.
 - .5 Review manufacturer's instructions and warranty requirements.
- .2 Scheduling:
 - .1 Schedule hydraulic seeding to coincide with preparation of soil surface.
 - .2 Schedule hydraulic seeding using grass mixtures and mixtures containing Crown Vetch, Trefoil, or an approved equivalent between dates recommended by regional agricultural departments.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for seeds, mixtures, mulches, tackifiers, fertilizers, liquid soil amendments, and micronutrients, including product characteristics, performance criteria, WHMIS SDSs, and limitations.

- .3 Test and evaluation reports: Certified test reports showing materials comply with specified performance characteristics and physical properties.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance instructions.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Applicators:
 - .1 Landscaping company: Member in good standing of Landscape Ontario Green for Life (LO).
 - .2 Landscape planting supervisor: Landscape horticulturist journey person or certified landscape horticulturist technician with softscape installation designation or equivalent.
 - .3 Landscape maintenance supervisor: Landscape horticulturist journey person or certified landscape horticulturist technician with turf maintenance designation or equivalent.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Label bags of fertilizer to identify masses in kg, mix components and percentages, dates of bagging, supplier's names, and lot numbers.
 - .2 Tag inoculant containers with expiry dates.
 - .3 Store fertilizer off ground, indoors, in dry location in clean, dry, well-ventilated area and in accordance with manufacturer's recommendations.

1.9 SITE CONDITIONS

- .1 Ambient conditions:
 - .1 Perform hydraulic seeding when ambient conditions are suitable for proper application.

1.10 WARRANTY

- .1 Extended warranty:
 - .1 For seeding, the 12-month warranty period is extended to one full growing season.
 - .2 The department representative will conduct an end-of-warranty site review.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Seed or sod: Grass species and types suitable to local growing conditions and drought resistant.
- .2 Seed:

- .1 Regulatory requirements:
 - .1 Comply with AAFC's Seeds Act and Seeds Regulations.
 - .2 Provide "Canada pedigreed grade" seeds in accordance with AAFC's Seeds Regulations.
- .2 Grass mixtures:
 - .1 Grade: Canada No. 1 lawn mixture.
 - .2 Performance/design criteria:
 - .1 Provide drought-resistant grass species and types suitable to local growing conditions.
- .3 Mulch: Specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors.
 - .1 Type I:
 - .1 Made from wood cellulose fibre.
 - .2 Organic matter content: 95% $\pm$ 0.5%.
 - .3 pH: 6.0.
 - .4 Potential water absorption: 900%.
 - .2 Type II:
 - .1 Made from newsprint, raw cotton fibre, and straw, processed to produce fibre lengths of 15 mm to 25 mm. Greater proportions of ingredients to be straw.
 - .3 Type III: Specialty mulch.
 - .1 Pourable, high performance, erosion control stabilized mulch matrix (SMM) bonded fibre matrix (BFM) flexible growth media (FGM).
- .4 Tackifier: Water dilutable, liquid dispersion.
- .5 Water: Free of impurities that would inhibit germination and growth.
- .6 Fertilizer: Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.
 - .1 Regulatory requirements: Comply with AAFC's Fertilizers Act and related regulations.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Verify ground is not frozen and is free of snow, ice, or standing water.
 - .2 Verify grades are correct.
 - .3 Verify ground is moist to minimum 150 mm depth.

3.2 PREPARATION

- .1 Protection of in-place conditions:

- .1 Protect structures, signs, guide rails, fences, plant material, utilities and other surfaces not intended for spray.
- .2 Immediately remove any material sprayed where not intended to the satisfaction of the department representative.
- .2 Surface preparation:
 - .1 Prepare seed beds in accordance with Section 01 71 00 - Examination and Preparation, and:
 - .1 Remove and dispose of weeds, debris, and stones 50 mm in diameter and larger.
 - .2 Fine grade surfaces free of humps and hollows to smooth, even grade, to contours and elevations indicated on Drawings to tolerance of ± 15 mm, surface draining naturally.
 - .3 Cultivate fine graded surfaces to 25 mm depth immediately before seeding.
 - .4 Loosen excessively compacted areas by thorough scarification, discing, or harrowing to a minimum 150 mm depth.
 - .2 Obtain written notice of acceptance of grades and topsoil depths from the department representative before starting to seed.

3.3 SLURRY PREPARATION

- .1 Measure quantities of materials by weight or weight-calibrated volume measurement acceptable to the Departmental Representative. 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 Charge tackifier into seeder after materials are well mixed in seeder; mix thoroughly to complete slurry.

3.4 SLURRY APPLICATION

- .1 Hydraulic seeding equipment:
 - .1 Slurry tank.
 - .2 Use slurry agitation system capable of operating during charging of tank and during seeding and consisting of recirculation of slurry or mechanical agitation method.
 - .3 Capable of seeding 50 m by hand operated hoses and appropriate nozzles. Supply with minimum six spray pattern nozzles.
 - .4 Tank volume to be certified by certifying authority and identified by authorities using a "Volume Certification Plate".
 - .5 Use pumps capable of maintaining continuous non-fluctuating flow of solution.
- .2 Slurry mixture applied per hectare:
 - .1 Refer to OPSS.MUNI 804 Construction Specifications for Seed and Cover
- .3 Apply slurry uniformly, at optimum angle for adhesion 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 305 mm onto adjacent grass areas or sodded areas and previous applications to form uniform surfaces.
- .5 Reapply where application is not uniform.
- .6 Remove slurry from items and areas not designated to be sprayed.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning.
- .2 Waste management:
 - .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal, and:
 - .1 Divert unused fertilizer from landfill to official hazardous material collections site.

3.6 PROTECTION

- .1 Erect plastic snow fence or other barriers acceptable to the department representative to protect seeded areas from vehicular or foot traffic until plants are established.
- .2 Maintain protective measures in good condition until acceptance by the department representative.

3.7 ESTABLISHMENT PERIOD MAINTENANCE

- .1 Maintain seeded areas from seed application until final review by the department representative.
- .2 Grass mixtures:
 - .1 Repair and reseed dead or bare spots to allow establishment of seed before acceptance.
 - .2 Water seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.
 - .3 Water seeded areas to maintain optimum soil moisture level for germination and continued growth. Control watering to prevent washouts.

3.8 WARRANTY PERIOD MAINTENANCE

- .1 Maintain seeded areas from final review until end of warranty period:
 - .1 Repair and reseed dead or bare spots to satisfaction of the department representative.
 - .2 Fertilize seeded areas. Spread half of required fertilizer in one direction and remainder at right angles. Water well.
 - .3 Water seeded area to maintain optimum soil moisture level for continued growth. Control watering to prevent washouts.

3.9 FINAL ACCEPTANCE

- .1 Seeded areas will be considered acceptable to the department representative when:
 - .1 Seeded areas are free of rutted, eroded, bare, or dead spots.
- .2 Areas seeded in fall will be considered acceptable to the department representative in following spring, 1 month after start of growing season, if acceptance conditions are met.

END OF SECTION

**SECTION 33 05 16
MAINTENANCE HOLES AND CATCH BASIN STRUCTURES**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS (NOT USED)

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A48/A48M-03(2012), Standard Specification for Grey Iron Castings.
 - .2 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM C117-13, Standard Test Method for Materials Finer than 75-mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM C139-11, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .6 ASTM C478M-13, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
 - .7 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .3 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .4 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
- .4 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 407-November 2007(R2010), Construction Specification For Maintenance Hole, Catch Basin, Ditch Inlet And Valve Chamber Installation.

1.3 MEASUREMENT PROCEDURES (NOT USED)

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 maintenance holes and catchbasin structures 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 Ontario, Canada.

1.5 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 43 00 - Quality Assurance.
- .2 Certifications:
 - .1 Submit manufacturer's test data and certification at least 4 weeks before beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

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 maintenance holes and catch basin structures from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Precast maintenance hole units: to ASTM C478M, circular or oval.
 - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
 - .2 Monolithic bases to be approved by department representative.
- .2 Precast catch basin sections: to ASTM C139, ASTM C478M.
- .3 Joints: made watertight using rubber rings, bituminous compound, epoxy resin cement or cement mortar.
- .4 Mortar:
 - .1 Masonry Cement: to CAN/CSA-A3002.
- .5 Ladder rungs: to CSA G30.18, No.25M billet steel deformed bars, hot dipped galvanized to ASTM A123/A123M.
 - .1 Rungs to be safety pattern (drop step type).

- .6 Adjusting rings: to ASTM C478M.
- .7 Concrete Brick: to CAN/CSA-A165 Series.
- .8 Drop maintenance hole pipe: same as sewer pipe.
- .9 Galvanized iron sheet: approximately 2 mm thick.
- .10 Steel gratings, I-beams and fasteners: as indicated.
- .11 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames.
 - .1 Frame with grating or cover to constitute one unit.
 - .2 Assemble and mark unit components before shipment.
 - .2 Maintenance hole frames and covers: cover cast with perforations and complete with two 25 mm square lifting holes to OPSS 407.
 - .3 Catch basin frames and covers: to OPSS 407.
 - .4 Size: 762 mm clear diameter.
- .12 Granular bedding and backfill: in accordance with Section 31 05 16 - Aggregate Materials.
 - .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

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 maintenance holes and catch basin structures installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of department representative.
 - .2 Inform department representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.
- .2 Obtain approval of department representative before installing maintenance holes or catch basins.

3.3 CONCRETE WORK

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Position metal inserts in accordance with dimensions and details as indicated.

3.4 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Complete units as pipe laying progresses.

- .3 Dewater excavation to approval of department representative and remove soft and foreign material before placing concrete base.
- .4 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% maximum dry density.
- .5 Precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.
 - .2 Make each successive joint watertight with department representative's approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
 - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .4 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
- .6 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Bench to provide smooth U-shaped channel.
 - .1 Side height of channel to be 0.5 times diameter of sewer.
 - .2 Slope adjacent floor at 1 in 20.
 - .3 Curve channels smoothly.
 - .4 Slope invert to establish sewer grade.
- .7 Compact granular backfill to 95% maximum dry density.
- .8 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
 - .2 Make joints watertight between new unit and existing pipe.
 - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .9 Set frame and cover to required elevation on no more than 4 courses of brick.
 - .1 Parge and make smooth and watertight.
- .10 Place frame and cover on top section to elevation as indicated.
 - .1 If adjustment required use concrete ring.
- .11 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .12 Install safety platforms in maintenance holes having depth of 5 m or greater, as indicated.

3.5 ADJUSTING TOPS OF EXISTING UNITS

- .1 Remove existing gratings and frames, and store for re-use at locations designated by department representative.
- .2 Sectional units:
 - .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
 - .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.
 - .1 When amount of raise is less than 600 mm use standard maintenance hole brick, modoloc or grade rings.
- .3 Monolithic units:
 - .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with mortared brick course for 150 mm or less alteration.
 - .2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.
 - .3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.
 - .4 Install additional maintenance hole ladder rungs in adjusted portion of units as required.
 - .5 Re-use existing gratings and frames.
 - .6 Re-set gratings and frames to required elevation on not more than 4 courses of brick.
 - .1 Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.
 - .2 Re-set gratings and frames to required elevation on full bed of cement mortar, parge and trowel smooth.

3.6 SEALING OVER EXISTING UNITS (NOT USED)

3.7 SITE QUALITY CONTROL

- .1 Leakage Test:
- .2 Install watertight plugs or seals on inlets and outlets of each new sanitary sewer maintenance hole and fill maintenance hole with water.
- .3 Leakage not to exceed 0.3% per hour of volume of maintenance hole.
- .4 If permissible leakage is exceeded, correct defects.
- .5 Repeat until approved by department representative.
- .6 department representative will issue Test Certificate for each maintenance hole passing test.

3.8 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.

- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

**SECTION 33 14 16
SITE WATER UTILITY DISTRIBUTION PIPING**

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Department of Justice Canada (Jus):
 - .1 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - .1 ANSI/AWWA B300-18, Standard for Hypochlorites
 - .2 ANSI/AWWA B301-18, Liquid Chlorine
 - .3 ANSI/AWWA B303-18, Sodium Chlorite
 - .4 ANSI/AWWA C500-19, Standard for Metal-Seated Gate Valves for Water Supply Service
 - .5 ANSI/AWWA C651-14, Standard for Disinfecting Water Mains
 - .6 ANSI/AWWA C800-21, Standard for Underground Service Line Valves and Fittings
 - .7 ANSI/AWWA C900-16, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution
- .3 ASTM International (ASTM):
 - .1 ASTM A53/A53M-20, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
 - .2 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .3 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength
 - .4 ASTM B88M-20, Standard Specification for Seamless Copper Water Tube (Metric)
 - .5 ASTM C117-17, Standard Test Method for Materials Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing
 - .6 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .7 ASTM C478/C478M-20, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
 - .8 ASTM D698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - .9 ASTM D2310-06, Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe

- .10 ASTM F714-21, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- .4 American Water Works Association (AWWA)/Manual of Practice:
 - .1 AWWA M11-2018, Steel Pipe - A Guide for Design and Installation
 - .2 AWWA M17-2016, Installation, Field Testing, and Maintenance of Fire Hydrants
- .5 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric
 - .3 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids
- .6 CSA Group (CSA):
 - .1 CAN/CSA-A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005)
 - .2 CAN/CSA-B137:20 Series, Thermoplastic Pressure Piping Compendium (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12)
 - .3 CSA G30.18-09, Carbon and Steel Bars for Concrete Reinforcement
- .7 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual, current edition
- .8 ULC Standards (ULC):
 - .1 CAN/ULC-S520:2016, Standard for Fire Hydrants
 - .2 CAN/ULC-S543-09, Standard for Internal-Lug, Quick Connect Couplings for Fire Hose

1.2 MEASUREMENT PROCEDURES (NOT USED)

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Schedule Work to minimize interruptions to existing services.
 - .1 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by department representative.
 - .2 Notify department representative, superintendent minimum of 24 hours in advance of interruption in service.
 - .3 Notify fire department of planned or accidental interruption of water supply to hydrants.
 - .4 Provide and post "Out of Service" sign on hydrant not in use.
 - .5 Advise local police department of anticipated interference with movement of traffic.

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, product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Pipe certification to be on pipe.
- .3 Shop Drawings: submit complete drawings and construction schedule for water mains 600 mm diameter and larger. Include method for installation of water main.
- .4 Samples:
 - .1 Inform department representative of proposed source of bedding materials and provide access for sampling at least 4 weeks before commencing work.
 - .2 Submit for testing 4 weeks minimum before beginning work, samples of materials proposed for use as follows:
 - .1 Granular A for pipe bedding and cover.
 - .3 Submit manufacturer's test data and certification that pipe materials meet requirements of this section 4 weeks minimum before beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for pipe, valves, valve boxes, valve chambers and hydrants for incorporation into manual.
- .3 Submit data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Packaging Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 MAINTENANCE MATERIAL SUBMITTALS (NOT USED)

PART 2 PRODUCTS

2.1 PIPE, JOINTS, AND FITTINGS

- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 150, DR 18, 1 MPa gasket bell end.
 - .1 CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket coupling.
 - .2 Composite epoxy impregnated fibreglass PVC pipe to ASTM D2996, class H. Unplasticized PVC core over wrapped with bonded fibreglass reinforced epoxy resin. Pressure class 300, 2.4 MPa with cast iron outside diameter and integral bell gasketed joints to ANSI/ASTM D2992. Material to ASTM D2310, classification RTRP-11HZ-5001-PVC-13223.
 - .3 Cast iron fittings: to ANSI/AWWA C110/A21.10, and for pipe diameters larger than NPS 4 cement mortar lined to ANSI/AWWA C104/A21.4.

2.2 PIPE PROTECTION (NOT USED)

2.3 VALVES AND VALVE BOXES

- .1 Valves to be right hand closing (clockwise)

- .2 Gate valves: to ANSI/AWWA C500, standard iron body, bronze mounted wedge valves with non-rising stems, suitable for 1 Pa with mechanical joints.
- .3 Cast iron valve boxes: sliding type adjustable over minimum of 450 mm complete with valve operating extension rod, 30 mm diameter, 25 x 25 mm cross section, of such length that when set on valve operating nut top of rod will not be more than 150 mm below cover.
 - .1 Base to be large round type with minimum diameter of 300 mm.
 - .2 Top of box to be marked "WATER"/"EAU".

2.4 VALVE CHAMBERS

- .1 Concrete and reinforcing steel: to Section 03 30 00 - Cast-in-Place Concrete and Section 03 20 00 - Concrete Reinforcing.
- .2 Precast concrete sections to ASTM C478/C478M. Cast ladder rungs integral with unit; site installation not permitted.
- .3 Valve chamber frames and covers: grey iron castings, minimum tensile strength 200 MPa, with two coats, shop applied, approved asphalt coating with a mass of approximately 215 kg per set.
 - .1 Design and dimensions as indicated.
 - .2 Cover to be marked "WATER"/"EAU".
- .4 Jointing materials:
 - .1 Manufacturer's rubber ring gaskets.
- .5 Ladder rungs for valve chambers: 20 mm diameter deformed rail steel bars to CSA G30.18, hot-dipped galvanized after fabrication to ASTM A123/A123M. Rungs to be safety pattern.

2.5 SERVICE CONNECTIONS

- .1 Copper tubing: to ASTM B88M type K, annealed.
- .2 Polyvinyl chloride pressure pipe: to CAN/CSA-B137.5, 1.1 MPa SDR 9
- .3 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .4 PVC joints: solvent welded in accordance with manufacturer's specifications.
- .5 Brass inverted key-type curb stops: red brass to ASTM B62, compression type without drains.
 - .1 Curb stops to have adjustable [bituminous coated] cast iron service box with stem to suit depth of bury.
 - .2 Top of cast iron box marked "WATER"/"EAU".
- .6 Service connections for PVC pipe:
 - .1 Service connections less than 100 mm: corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
 - .2 Service connections 100 mm and over: use tee fitting or tapping valve and sleeve.
- .7 Bronze type service clamps: for PVC pipe service connections.

- .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
- .2 Clamps to be tapped with threads to ANSI/AWWA C800.
- .8 Tee connections: for services above NPS 1. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

2.6 HYDRANTS

- .1 Post type hydrants: compression type hydrant, to CAN/ULC-S520, designed for working pressure of 1210 kPa with two 63.5 mm threaded hose outlets, one 100 mm quick connect pumper connection, 150 mm riser barrel, 125 mm bottom valve and 150 mm connection for main.
 - .1 Hydrants to open clockwise, CSA standard threads, fittings to be internal lug quick-connect to CAN/ULC-S543. Provide metal caps.
 - .2 Provide key operated gate valve located 1 m from hydrant.
 - .3 Depth of bury 1.8 m.
- .2 Hydrant paint: exterior enamel to MPI #96, yellow.

2.7 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C136 /C136M and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

2.8 BACKFILL MATERIAL

- .1 As indicated. In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.9 PIPE DISINFECTION

- .1 Sodium hypochlorite to ANSI/AWWA B300 or Liquid Chlorine to ANSI/AWWA B301 to disinfect water mains.
- .2 Disinfect water mains in accordance with ANSI/AWWA C651/05.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrates previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrates in presence of department representative.
 - .2 Inform department representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from department representative.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of department representative.
 - .2 Remove defective materials from site as directed by department representative.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Ensure trench depth allows coverage over pipe of 1.8 m minimum from finished grade or as indicated on the contract drawings.
- .3 Trench alignment and depth require department representative's approval before placing bedding material and pipe.

3.4 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Place concrete to details as indicated in the contract drawings.
- .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 hours after placing.

3.5 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 95% minimum of maximum dry density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling with compacted bedding material.

3.6 PIPE INSTALLATION

- .1 Terminate building water service at property line opposite point of connection to main.
 - .1 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Lay pipes to manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as specified.
- .3 Join pipes in accordance with manufacturer's recommendations.
- .4 Bevel or taper ends of PVC pipe to match fittings.
- .5 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .6 Lay pipes on prepared bed, true to line and grade.

- .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .2 Take up and replace defective pipe.
- .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 4 m.
- .7 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .8 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .9 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .10 Position and join pipes with equipment and methods approved by department representative.
- .11 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Align pipes before jointing.
- .13 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .14 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
- .15 Complete each joint before laying next length of pipe.
- .16 Minimize deflection after joint has been made.
- .17 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .18 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by department representative.
- .19 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .20 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .21 Do not lay pipe on frozen bedding.
- .22 Do hydrostatic and leakage test and have results approved by Departmental Representative, department representative before surrounding and covering joints and fittings with granular material.
- .23 Backfill remainder of trench.

3.7 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of Bedding same as adjacent pipe. Valves not to be supported by pipe.

- .3 Install underground post-type indicator valves as indicated.

3.8 VALVE CHAMBERS

- .1 Use precast units as approved by department representative.
- .2 Construct units as indicated, plumb and centred over valve nut, true to alignment and grade, and not resting on pipe.
- .3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details indicated and in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .4 Plug lifting holes with precast concrete plugs set in cement mortar, or with grout.
- .5 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.
- .6 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.

3.9 UNDERCROSSING (NOT USED)

3.10 SERVICE CONNECTIONS

- .1 Terminate building water service at property line opposite point of connection to main.
 - .1 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops 300mm in right-of-way.
- .4 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .5 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .6 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .7 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m minimum, whichever is greater.
- .8 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .9 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .10 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
- .11 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.11 HYDRANTS ASSEMBLIES

- .1 Install hydrants at locations as indicated.
- .2 Install hydrants in accordance with AWWA M17.
- .3 Install 150 mm gate valve and cast iron valve box on hydrant service leads as indicated.
- .4 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade.
- .5 Place concrete thrust blocks as indicated and specified.
- .6 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.
- .7 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.12 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by department representative.
- .3 Keep joints and watermain corporation std couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by department representative.

3.13 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C605, OPSS 441, OPSS 701.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify department representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of department representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by department representative.
- .6 Upon completion of pipe laying and after department representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.
- .7 Leave hydrants, valves, joints and fittings exposed.
- .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .11 Expel air from main by slowly filling main with potable water.

- .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
- .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .12 Thoroughly examine exposed parts and correct for leakage as necessary.
- .13 Apply leakage test pressure of 1050 kPa minimum to a maximum of after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
- .14 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .15 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .16 Repeat hydrostatic test until defects have been corrected.
- .17 Define leakage as amount of water supplied from water storage tank or meter in order to maintain test pressure for 2 hours.
- .18 Do not exceed allowable leakage of 0.082 L/mm of pipe diameter per kilometer or pipe length, including lateral connections.
- .19 Locate and repair defects if leakage is greater than amount specified.
- .20 Repeat test until leakage is within specified allowance for full length of water main.

3.14 PIPE SURROUND

- .1 Upon completion of pipe laying and after department representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% of maximum dry density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% of maximum dry density.

3.15 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 98% maximum dry density.
 - .1 In other areas, compact to at least 95% corrected maximum dry density.

3.16 HYDRANT FLOW TESTS

- .1 Conduct flow tests on every hydrant to determine fire flows before painting hydrant caps and ports.

3.17 PAINTING OF HYDRANTS

- .1 After installation, paint hydrants yellow.

- .2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

3.18 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by Departmental Representative and department representative, carried out by specialist contractor or local water work department.
 - .1 Notify Departmental Representative and department representative at least 5 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 15 minutes, or until foreign materials have been removed and flushed water is clear.
- .3 Flushing flows as follows:

Pipe Size NPS	Flow (L/s) Minimum
150 and below	38
200	75
250	115
300	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 When flushing has been completed to department representative approval, introduce strong solution of chlorine as approved by department representative into water main and ensure that it is distributed throughout entire system.
- .7 Chlorine application to be close to point of filling water main and to occur at same time.
- .8 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .9 Measure chlorine residuals at extreme end of pipe-line being tested.
- .10 After adequate chlorine residual between 40 mg/l and not more than 100 mg/l has been obtained leave system charged with chlorine solution for 24 hours.
- .11 After 24 hours, take further samples to ensure that there is still not less than 25 mg/l of chlorine residual remaining throughout system.
- .12 Flush line to remove chlorine solution after 24 hours.
- .13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of 2 days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
 - .3 Specialist contractor to submit certified copy of test results.
- .14 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.

3.19 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by department representative.

END OF SECTION

**SECTION 33 14 16.13
INCOMING SITE WATER UTILITY DISTRIBUTION PIPING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 33 14 16 - Site Water Utility Distribution Piping

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C901-08, AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ Inch (13 mm) through 3 Inch (76 mm), for Water Service.
- .2 ASTM International (ASTM)
 - .1 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 Manufacturer's Standardization Society of the Valve and Fittings Industry
 - .1 MSS-SP-70-11, Grey Iron Gate Valves, Flanged and Threaded Ends.
- .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2015 (NPC).

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 valves, couplings and mechanical joints and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 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 and protect piping materials from nicks, scratches, and blemishes.
 - .2 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 PIPE

- .1 Service water pipe: polyethylene (PE) from 1 m outside of building or as indicated in.
 - .1 Polyethylene (PE) pipe: ANSI/AWWA C901.

2.2 CATHODIC PROTECTION

- .1 Cathodic Protection: to Section 26 42 00.01 - Telethermics: Cathodic Protection.

2.3 FITTINGS

- .1 NPS 3 and larger mechanical joints : to ANSI/AWWA C110/A21.10.

2.4 JOINTS

- .1 Rubber gaskets for mechanical joints: to ANSI/AWWA C111/A21.11.
- .2 Bolts, nuts, hex head with washers: to ASTM A307, heavy series.

2.5 GATE VALVES

- .1 Rising stem: to MSS SP-70, class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet.

2.6 PROTECTIVE COATING (NOT USED)

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 distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of department representative.
 - .2 Inform department representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install in accordance with local authority having jurisdiction.
- .2 Piping cut square, reamed, free of cuttings and foreign material.
- .3 Minimum depth of bury: 1.8m.
- .4 Lay buried piping in compacted washed sand in accordance with AWWA Class "B" bedding, where existing ground below bedding is unstable, install pipe on continuous concrete support.
- .5 Where piping enters building, provide support, and seal with approved construction sealants against ingress of moisture; to approval of authority having jurisdiction.
- .6 Assemble piping using fittings manufactured to ANSI standards and in accordance with manufacturer's instructions.

3.3 PRESSURE TESTING

- .2 Conform to Section 33 14 16 - Site Water Utility Distribution Piping

.1 3.4 Disinfection

.1 Co-ordinate with Section 33 14 16 - Site Water Utility Distribution Piping.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

END OF SECTION

**SECTION 33 31 11
PUBLIC SANITARY SEWERAGE GRAVITY PIPING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 31 05 16 - Aggregate for Earthwork
- .3 Section 31 11 00 - Clearing and Grubbing
- .4 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .5 Section 33 05 16 – Maintenance Holes and Catchbasin Structures

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - .1 ANSI/AWWA C900-22, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
- .2 ASTM International (ASTM):
 - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM C117-23, Standard Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
 - .3 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .4 ASTM C443-21, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - .5 ASTM C478/C478M-22, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
 - .6 ASTM D698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - .7 ASTM D1785-21a, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - .8 ASTM D2241-24, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
 - .9 ASTM D2680-20, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping
 - .10 ASTM D3350-21, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

- .11 ASTM F2487-21, Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene and Polypropylene Pipelines
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric
- .4 CSA Group (CSA):
 - .1 CSA A257 Series:19, Standards for concrete pipe and manhole sections
 - .2 CSA A3000-18, Cementitious materials compendium
 - .1 CSA A3001-18, Cementitious materials for use in concrete
 - .3 CSA B1800-18, Thermoplastic nonpressure piping compendium
 - .1 CSA B182.1-18, Plastic drain and sewer pipe and pipe fittings
 - .2 CSA B182.2-18, PSM type polyvinylchloride (PVC) sewer pipe and fittings
 - .3 CSA B182.6-18, Profile polyethylene (PE) sewer pipe and fittings for leak-proof sewer applications
 - .4 CSA B182.11-18, Standard practice for the installation of thermoplastic drain, storm, and sewer pipe and fittings

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Product literature and data sheets for pipes and fittings, including product characteristics, performance criteria, dimensions, WHMIS SDS's and limitations.
- .3 Shop Drawings:
 - .1 Signed and sealed by a qualified professional in accordance with Section 01 43 00 – Quality Assurance.
 - .2 Include:
 - .1 Proposed method of installation for sewerage installation drawings.
 - .2 Concrete placement details.
 - .3 Joint connections details.
 - .4 Blocking method to guide sanitary sewer pipe in true alignment.
 - .5 Proposed method for installing carrier pipe for undercrossing.
- .4 Samples:
 - .1 Submit proposed source of bedding materials and provide access for sampling minimum 4 weeks before beginning the Work.
- .5 Manufacturer's Instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Flushing procedures.
- .6 Site Quality Control Submittals:
 - .1 Indicating results of tests specified in SITE QUALITY CONTROL.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements
 - .1 Store and handle pipes, fittings and accessories to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.
 - .2 Prevent damage to machined ends of pipes while handling and moving pipe.
- .2 Carefully examine delivered materials to confirm type and grade of material.
- .3 Handle pipe:
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

PART 2 PRODUCTS

2.1 DESCRIPTION (NOT USED)

2.2 MATERIALS

- .1 Plastic Pipe
 - .1 Type PSM Polyvinyl Chloride (PVC): To CSA B182.2.
 - .1 Standard Dimensional Ratio (SDR) 35, to ASTM D2241.
 - .2 Locked-in gasket and integral bell system.
 - .3 Nominal lengths: 4 m.
 - .4 Schedule 40, to ASTM D1785, for PVC pipe and fittings less than 100 mm diameter.
 - .5 For PVC and fittings less than 100 mm diameter: To ASTM D1785, Schedule 40.
 - .2 Acrylonitrile - Butadiene - Styrene (ABS): To CSA B182.2.
- .2 Service Connections
 - .1 Type PSM Poly (Vinyl) Chloride: To CSA B182.2.
 - .2 Plastic Pipe: To CSA B182.1, with push-on joints.
 - .3 Plugs: Pre-fabricated plugs.
- .3 Cement Mortar:
 - .1 Portland Cement: To CSA A3000 (specifically CSA A3001), normal type 10.
 - .2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry.
 - .1 Add only sufficient water after mixing to give optimum consistency for placement.
 - .2 Do not use additives.
- .4 Concrete grout in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .5 Manhole:

- .1 Precast Manhole: To ASTM C478/C478M and in accordance with Section 33 05 16 – Maintenance Holes and Catchbasin Structures
- .2 Ladder Rungs: To ASTM C478, 19 mm diameter aluminum to CSA S157/S157.1.
- .3 O-Ring Rubber Gaskets: To ASTM C443

2.3 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 05 16 - Aggregate for Earthwork.
- .2 Concrete mixes and materials for cradles, encasement, supports: In accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.4 BACKFILL MATERIAL

- .1 Type 1, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 – Examination and Preparation.
 - .2 Verify removal of trees, brush vegetation, tree stumps, and roots is completed in accordance with Section 31 11 00 - Clearing and Grubbing.

3.2 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site.

3.3 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Provide erosion and sediment control measures in accordance with Section 01 57 00 - Temporary Controls.
- .3 Protect trench from contents of sewer or sewer connection.
- .4 Trench alignment and depth require review from department representative before placing bedding material and pipe.

3.4 CONCRETE BEDDING AND ENCASEMENT (NOT USED)

3.5 GRANULAR BEDDING

- .1 Place granular bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth as indicated on the Drawings.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to minimum 95% maximum dry density.

- .6 Fill excavation below design elevation of specified bedding adjacent to manholes or structures with compacted bedding material.

3.6 INSTALLATION

- .1 Install pipe, pipe fittings, and appurtenances at locations indicated on the Drawings.
 - .1 Install plastic pipe and fittings in accordance with CSA B182.11.
- .2 Lay and join pipes in accordance with manufacturer's recommendations, referenced standards and acceptable to department representative.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Barrel of each pipe to be in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Joint deflection permitted within limits recommended by pipe manufacturer.
- .6 Water to flow through pipe during construction, only as permitted by department representative.
- .7 When stoppage of Work occurs, block pipes as directed by department representative to prevent entry of foreign materials.
- .8 Plug lifting holes with pre-fabricated plugs, set in shrinkage compensating grout.
- .9 Cut pipes as required for special inserts, fittings, or closure pieces as recommended by pipe manufacturer without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .10 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .11 Use pre-fabricated saddles or site connections, for connecting pipes to existing sewer pipes.
 - .1 Joints to be structurally sound and watertight.
- .12 Pipe Surround:
 - .1 Place surround material in unfrozen condition.
 - .2 Surround and cover pipes as indicated on the Drawings after completion of pipe laying, and review of the pipe joints by department representative.
 - .1 Leave joints and fittings exposed until site testing is completed.
 - .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness, as indicated on the Drawings.
 - .4 Place layers uniformly and simultaneously on each side of pipe.
 - .5 Compact each layer from pipe invert to mid height of pipe to minimum 95% maximum dry density.
 - .6 Compact each layer from mid height of pipe to underside of backfill elevation to at least 95% maximum dry density.
 - .7 When site test results are acceptable to department representative, place surround material at pipe joints.
- .13 Backfill:

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated on the Drawings.
- .3 Under paving and walks, compact backfill to minimum 98% maximum dry density.
 - .1 In other areas, compact to minimum 95% maximum dry density.

.14 Service Connections:

- .1 Install pipe to CSA B182.11 and manufacturer's instructions.
- .2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal (2%).
- .3 Service connections to main sewer: Standard Tee or Wye fittings, or department representative reviewed saddles.
 - .1 Do not use break-in and mortar patch-type joints.
- .4 Do not extend service connection pipe into interior of main sewer.
- .5 Make up required horizontal and vertical bends from 45° bends or less, separated by straight section of pipe with minimum length of 4 pipe diameters.
 - .1 Use long sweep bends where applicable.
- .6 Plug service laterals with water tight caps or plugs.
- .7 Place location marker at the ends of unconnected plugged or capped sewer lines.
 - .1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

.15 Manhole

- .1 Manhole locations as indicated on the Drawings.
- .2 Excavate, backfill, and compact manhole bases in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Construct manhole as indicated on the Drawings and in accordance with Section 33 05 16 – Maintenance Holes and Catchbasin Structures

3.7 UNDERCROSSING (NOT USED)

3.8 SITE QUALITY CONTROL

.1 Site Tests and Inspections:

- .1 Perform in accordance with Section 01 45 00 – Quality Control.
 - .1 Carry out inspection of installed sewers by video camera, digital camera or by other related means.
- .2 When directed by department representative, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to verify that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.

- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .6 Repair and retest sewer line as required, until test results are within limits specified.
- .7 Repair visible leaks regardless of test results.

3.9 CLEANING

- .1 Perform in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

**SECTION 33 41 16
SUB-DRAINAGE PIPING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregates for Earthwork
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 DEFINITIONS

- .1 Industry average environmental product declaration: Developed by an industry association and represents the average product of multiple companies. Products covered by industry average environmental product declarations are required to follow the same product category rule. Industry average environmental product declarations cannot represent a certain manufacturer or its product. Industry average environmental product declarations may be referred to as "industry-wide environmental product declarations" or "generic environmental product declarations".
- .2 Product-specific type III environmental product declaration: Provides data on one product made by one manufacturer, but can involve multiple factories. Product-specific type III environmental product declarations can cover a product produced by a manufacturer in several plants throughout the world if all plants use the same processes. Product-specific environmental product declarations cannot represent several products and several manufacturers.

1.4 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .2 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric
- .3 CSA Group (CSA):
 - .1 CSA B1800-18, Thermoplastic non-pressure piping compendium
 - .1 CSA B182.1-18, Plastic drain and sewer pipe and pipe fittings
 - .2 CAN/CSA-G401-14, Corrugated steel pipe products

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product data: Product literature and data sheets for pipes, fittings, including product characteristics, performance criteria, dimensions, and limitations.
- .3 Manufacturer's instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Flushing procedures.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance data:
 - .1 Include, in the operation and maintenance manual, manufacturer's maintenance instructions and recommended cleaning materials and methods.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and:
 - .1 Carefully examine delivered materials to confirm type and grade of material.
 - .2 Prevent damage to machined ends of pipes while handling and moving pipes.
 - .1 Do not use chains or cables passed through rigid pipe bore so the weight of pipe bears upon pipe ends.

1.8 SITE CONDITIONS

- .1 Examine geotechnical data as indicated in Section 00 31 00 - Available Project Information.
- .2 Dewatering: In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Known underground utility lines and buried objects are as indicated on Drawings.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Regulatory requirements:
- .2 Perforated plastic pipe and fittings: To CSA B182.1.
- .3 Bedding gravel or crushed stone: Hard, durable particles, graded evenly in sizes from 16 to 8 mm.
- .4 Granular filter material: In accordance with Section 31 05 16 - Aggregates for Earthwork, and:
- .5 Geotextile filter: In accordance with Section 31 32 19.16 - Geotextile Soil Stabilization.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation, and:

- .1 Verify graded base conforms with required drainage pattern before placing bedding material.
- .2 Remedy improper slopes, unstable areas, areas requiring additional compaction, and other unsatisfactory conditions.

3.2 TRENCHING

- .1 Trench and backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Provide erosion and sediment control measures in accordance with Section 01 57 00 - Temporary Controls.
- .3 Place bedding material after review of excavations by the department representative.

3.3 BEDDING PLACEMENT

- .1 Place 100 mm layer of bedding material to full trench width and compact to minimum 95% of maximum dry density.

3.4 PIPE SUB-DRAIN INSTALLATION

- .1 Lay pipe drains on prepared bed, true to line and grade, with inverts smooth and free of sags or high points.
 - .1 Install pipes with barrels in contact with bed throughout full length.
- .2 Begin laying at outlet and proceed in upstream direction.
- .3 Lay perforated pipes with perforations downwards at 4 o'clock and 8 o'clock positions.
- .4 Lay bell and spigot pipe with bell ends facing upstream.
 - .1 Do not mortar joints.
- .5 Make joints tight in accordance with manufacturer's instructions.
- .6 Make watertight connections to existing drains, new or existing manholes, and catch basins as indicated on Drawings.
- .7 Plug open upstream ends of pipes with watertight concrete, steel, or wood bulkheads.
- .8 Surround material placement: Wrap or sleeve perforated pipe with geotextile filter and cover drain with filter material in uniform 150 mm layers as indicated on Drawings,
 - .1 Compact filter material to minimum 95% of maximum dry density.
- .9 Backfill remainder of trench in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .10 Do not place bedding, surround, or backfill materials in frozen conditions.
- .11 Protect sub-drains against flotation during installation.
- .12 Install "Y" connections to surface for flushing as indicated on Drawings.

3.5 CONNECTIONS TO MUNICIPAL FACILITIES

- .1 Connect pipe sub-drains to municipal storm sewer system as indicated on Drawings.

3.6 INSTALLATION - FRENCH DRAINS (NOT USED)

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning.
- .2 Waste management:

- .1 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal

End of Section

**SECTION 33 42 11
STORMWATER GRAVITY PIPING**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 31 05 16 - Aggregate for Earthwork
- .3 Section 31 11 00 - Clearing and Grubbing
- .4 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .5 Section 33 05 16 – Maintenance Holes and Catchbasin Structures

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - .1 ANSI/AWWA C900-22, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
- .2 ASTM International (ASTM):
 - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM C12-22a, Standard Practice for Installing Vitrified Clay Pipe Lines
 - .3 ASTM C14M-20, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain and Culvert Pipe (Metric)
 - .4 ASTM C76M-22a, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric)
 - .5 ASTM C117-23, Standard Test Method for Material Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing
 - .6 ASTM C136/C136M-19, Standard Method for Sieve Analysis of Fine and Coarse Aggregates
 - .7 ASTM C425-22, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
 - .8 ASTM C443M-21, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
 - .9 ASTM C478/C478M-22, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
 - .10 ASTM C506M-22a, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe (Metric)

- .11 ASTM C507M-22, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe (Metric)
- .12 ASTM C700-18, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
- .13 ASTM C828-23, Standard Test Method for Low-pressure Air Test of Vitrified Clay Pipe Lines
- .14 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- .15 ASTM D1056-20, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
- .16 ASTM D2680-20, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping
- .17 ASTM D3034-24, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- .18 ASTM F405-13, Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings
- .19 ASTM F667/F667M-16, Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
- .20 ASTM F794-21, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
- .21 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric
- .3 CSA Group (CSA):
 - .1 CSA A257 Series:19, Standards for concrete pipe and manhole sections
 - .2 CSA A3000-18, Cementitious materials compendium
 - .1 CSA A3001-18, Cementitious materials for use in concrete
 - .3 CSA B1800-18, Thermoplastic non-pressure piping Compendium
 - .1 CSA B181.1-18, Acrylonitrile-butadiene-styrene (ABS) drain, waste, and vent pipe and pipe fittings
 - .2 CSA B182.1-18, Plastic drain and sewer pipe and pipe fittings
 - .3 CSA B182.2-18, PSM type polyvinylchloride (PVC) sewer pipe and fittings
 - .4 CSA B182.11-18, Standard practice for the installation of thermoplastic drain, storm, and sewer pipe and fittings
 - .4 CAN/CSA G401-14, Corrugated steel pipe products
 - .5 CSA S157/S157.1-17, Strength design in aluminum/Commentary on CSA S157-17, Strength design in aluminum

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for pipes, fittings, and backfill, including product characteristics, performance criteria, dimensions, WHMIS SDS's and limitations.
- .3 Shop drawings:

- .1 Signed and sealed by a qualified professional in accordance with Section 01 43 00 - Quality Assurance.
- .2 Include:
 - .1 Proposed method of installation for stormwater installation drawings.
 - .2 Concrete placement details.
 - .3 Joint connections details.
 - .4 Blocking method to guide stormwater pipe in true alignment.
- .4 Manufacturer's instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Flushing procedures.
- .5 Source quality control submittals:
 - .1 Submit proposed source of bedding materials and provide access for sampling minimum 4 weeks before beginning the Work.
- .6 Site quality control submittals:
 - .1 Indicating results of tests specified in SITE QUALITY CONTROL.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Store and handle pipes, fittings and accessories to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.
 - .2 Prevent damage to machined ends of pipes while handling and moving pipe.
- .2 Carefully examine delivered materials to confirm type and grade of material.

1.7 SITE CONDITIONS

- .1 Dewatering: In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Examine subsurface investigation report as indicated in Section 00 31 00 - Available Project Information.
- .3 Known underground utility lines and buried objects are as indicated on the Drawings.

PART 2 PRODUCTS

2.1 DESCRIPTION

- .1 Regulatory requirements (Not Used)

2.2 MATERIALS

- .1 High Density Polyethylene (HDPE) pipe:
 - .1 Corrugated HDPE pipe: To CSA B182.6, ASTM F2306M, ASTM F667M

- .1 Standard dimensional ratio (SDR): To ASTM F2306M, ASTM F2648
- .2 Locked-in gasket and integral bell system.
- .3 Nominal lengths: 6 m.
- .4 HDPE and fittings less than 300 mm diameter: To ASTM F2306M, ASTM F477
- .2 Corrugated high density polyethylene pipe: To ASTM F667M ASTM F405.
- .2 Service connections:
 - .1 HDPE: To CSA B182.6, ASTM F905
 - .2 HDPE pipe: To CSA B182.6, with push-on joints.
 - .3 Plugs: Pre-fabricated plugs.
- .3 Joint mortar:
 - .1 Portland cement: To CSA A3000 (specifically CSA A3001), normal type 10
 - .2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry.
 - .1 Add only sufficient water after mixing to give optimum consistency for placement.
 - .2 Do not use additives.
- .4 Concrete grout: In accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .5 Manhole:
 - .1 Precast manhole: To ASTM C478/C478M and in accordance with Section 33 05 16 – Maintenance Holes and Catchbasin Structures.
 - .2 Ladder rungs: To ASTM C478/C478M, 19 mm diameter aluminum to CSA S157/S157.1.
 - .3 O-ring rubber gaskets: To ASTM C443M.

2.3 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material: In accordance with Section 31 05 16 - Aggregate for Earthwork.
- .2 Concrete mixes and materials for bedding, cradles, encasement, supports: In accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.4 BACKFILL MATERIAL

- .1 As indicated on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation.
 - .2 Verify removal of trees, brush vegetation, tree stumps and roots is completed in accordance with Section 31 11 00 - Clearing and Grubbing.

3.2 PREPARATION

- .1 Remove trees, brush vegetation, tree stumps and roots in accordance with Section 31 11 00 - Clearing and Grubbing.
- .2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Provide erosion and sediment control measures in accordance with Section 01 57 00 - Temporary Controls and temporary controls.
- .3 Trench alignment and depth require department representative's review before placing bedding material and pipe.

3.4 CONCRETE BEDDING AND ENCASEMENT

- .1 Perform concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Place concrete to details as indicated on the contract drawings.
- .2 Position pipe on concrete blocks to facilitate placing of concrete.
 - .1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Backfill over concrete once cured.

3.5 GRANULAR BEDDING

- .1 Place granular bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm.
- .3 Shape bed true to grade and to provide continuous and uniform bearing surface for the pipe.
 - .1 Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to minimum 95% maximum dry density.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted common backfill.

3.6 INSTALLATION

- .1 Install pipe, pipe fittings, and appurtenances at locations indicated on the Drawings.
 - .1 Install plastic pipe and fittings in accordance with CSA B182.11.
- .2 Lay and join pipe in accordance with manufacturer's recommendations and acceptable to department representative.
- .3 Lay pipes on prepared bed, true to line, and grade with pipe inverts smooth and free of sags or high points.
 - .1 Confirm barrel of each pipe is in contact with shaped bed throughout its full length.

- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Lay corrugated steel pipe:
 - .1 With outside circumferential laps facing upgrade and longitudinal laps or seams at side or quarter points.
 - .2 With longitudinal centre line of paved invert coinciding with flow line.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Water to flow through pipes during construction only when permitted by department representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Joints:
 - .1 Corrugated steel pipe:
 - .1 Install gaskets as recommended by manufacturer.
 - .2 Match corrugations or indentations of coupler band with pipe sections before tightening.
 - .3 Tap coupler firmly while tightening, to take up slack and provide snug fit.
 - .4 Insert and tighten bolts.
 - .2 Concrete and clay pipe:
 - .1 Install gaskets as recommended by manufacturer.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel, and other foreign material.
 - .5 Protect gaskets from displacement and contamination. Remove disturbed or contaminated gaskets; keep clean and free from dirt. Lubricate before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Apply sufficient pressure to make complete joints as outlined in manufacturer's recommendations.
 - .8 Mortared joints:
 - .1 For bell and spigot pipes, apply layer of mortar to the bottom half of bell end and layer of mortar to the top half of spigot end.
 - .1 Align spigot end and bell end and confirm that applied mortar on both ends is in contact when pipes are joined.
 - .2 Allow mortar to set for minimum of 1 hour before backfilling.
- .10 When any stoppage of Work occurs, restrain pipes as directed by department representative, to prevent "creep" during down time.
- .11 Plug lifting holes with prefabricated plugs, set in shrinkage compensating grout.

- .12 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes and catch basins.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .14 Use prefabricated saddles or approved field connections for connecting pipes to existing stormwater pipes.
 - .1 Joint to be structurally sound and watertight.
- .15 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.
- .16 Pipe Surround:
 - .1 Place surround material in unfrozen condition.
 - .2 Surround and cover pipes as indicated on the Drawings after completion of pipe laying, and review of the pipe joints by department representative.
 - .1 Leave joints and fittings exposed until site tests and inspections are completed.
 - .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated on the Drawings.
 - .4 Place layers uniformly and simultaneously on each side of pipe.
 - .5 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum dry density.
 - .6 Compact each layer from mid height of pipe to underside of backfill elevation to at least 95% maximum dry density.
 - .7 Water jetting of backfill under haunches of corrugated steel pipe may be permitted if recommended by manufacturer and acceptable to department representative.
 - .8 When site test results indicate compliance with specified requirements, and are acceptable to department representative, place surround material at pipe joints.
- .17 Backfilling
 - .1 Place backfill material in unfrozen condition.
 - .2 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated on the Drawings.
 - .3 Under paving and walks, compact backfill to at least 98% maximum dry density.
 - .1 In other areas, compact backfill to at least 95% maximum dry density.
- .18 Manhole
 - .1 Maximum distance between manholes as indicated on the Drawings.
 - .2 Manhole locations as indicated on the Drawings.
 - .3 Excavate, backfill, and compact manhole bases in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
 - .4 Construct manhole as indicated on the Drawings and in accordance with Section 33 05 16 – Maintenance Holes and Catchbasin Structures.

3.7 UNDERCROSSING (NOT USED)

3.8 SITE QUALITY CONTROL

- .1 Site tests and inspections:
 - .1 Perform in accordance with Section 01 45 00 - Quality Control.
 - .1 Carry out inspection of installed stormwater by video camera, digital camera or by other related means.
- .2 Draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through stormwater to ensure that pipe is free of obstruction as directed by department representative.
- .3 Remove foreign material from stormwater and related appurtenances by flushing with water.
- .4 Repair and retest stormwater line as required, until test results are within limits specified.
- .5 Repair visible leaks regardless of test results.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

**SECTION 33 42 13
STORMWATER CULVERTS**

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 31 05 16 - Aggregate for Earthwork
- .3 Section 31 11 00 - Clearing and Grubbing
- .4 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .5 Section 31 24 13 - Roadway Embankments

1.2 PRICE AND PAYMENT PROCEDURES

- .1 This item forms part of the stipulated contract lump sum.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C14M-20, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain and Culvert Pipe (Metric)
 - .2 ASTM C76M-22a, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric)
 - .3 ASTM C117-23, Standard Test Method for Material Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing
 - .4 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - .5 ASTM C144-18, Standard Specification for Aggregate for Masonry Mortar
 - .6 ASTM C443M-21, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
 - .7 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - .8 ASTM D1056-20, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
 - .9 ASTM D1248-16, Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
 - .10 ASTM F667/F667M-16, Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.2-M 88, Sieves, Testing, Woven Wire, Metric
- .3 CSA Group (CSA):
 - .1 CSA A257 Series:19, Standards for Concrete Pipe and Manhole Sections

- .2 CSA A3000-18, Cementitious Materials Compendium
 - .1 CSA A3001-18, Cementitious materials for use in concrete
- .3 CAN/CSA G401-14, Corrugated Steel Pipe Products

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: Product literature and data sheets for pipes, and fittings, including product characteristics, performance criteria, dimensions, WHMIS SDS's and limitations.
- .3 Source Quality Control Submittals:
 - .1 Submit proposed source of bedding materials and provide access for sampling minimum 4 weeks before beginning the Work.
- .4 Manufacturer's instructions:
 - .1 Special delivery, storage, and handling requirements.
 - .2 Installation instructions.
 - .3 Flushing procedures.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Store and handle pipes, fittings and accessories to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.
 - .2 Prevent damage to machined ends of pipes while handling and moving pipe.
- .2 Carefully examine delivered materials to confirm type and grade of material.

1.7 SITE CONDITIONS

- .1 Dewatering: In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Examine subsurface investigation report as indicated in Section 00 31 00 - Available Project Information.
- .3 Known underground utility lines and buried objects are as indicated on the Drawings.

PART 2 PRODUCTS

2.1 DESCRIPTION

- .1 Regulatory requirements:
 - .1 Identification:
 - .1 Cast, stamp or indelibly mark every length of pipe and every fitting with the maker's name or mark and the weight or class or quality of the product, or mark in accordance with the relevant standard.

2.2 MATERIALS

- .1 Corrugated steel pipe:
 - .1 Corrugated steel pipe and couplers, fittings, and appurtenances: To CAN/CSA-G401.
 - .1 Gaskets: To ASTM D1056.
 - .2 Coatings: Galvanized.
 - .2 Prefabricated Headwalls: As indicated on the Drawings.
- .2 Concrete pipe:
 - .1 Reinforced concrete pipe: To CSA A257, as indicated on the Drawings.
 - .2 Rubber gaskets for joints: To CSA A257.
 - .3 Bituminous joint compound: In accordance with manufacturer recommendations.
 - .4 Cement mortar joint filler:
 - .1 Portland cement: To CSA A3000 (specifically CSA A3001).
 - .2 Sand: To ASTM C144.
 - .3 Mortar: One part by volume of cement to two parts of clean, sharp sand mixed dry. Add sufficient water after mixing to give optimum consistency for hand application.
- .3 Corrugated high density polyethylene pipe and fittings: To ASTM F667/F667M.
 - .1 Polyethylene resin: To ASTM D1248, grade W8.
 - .2 Weathering resistance: To ASTM D1248, Class C.

2.3 GRANULAR BEDDING AND SURROUND MATERIAL

- .1 Granular bedding and surround material: In accordance with Section 31 05 16 - Aggregate for Earthwork and the following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified in Section 31 05 16 – Aggregate for Earthwork.
- .2 Concrete mixes and materials for bedding, cradles, encasement, supports: In accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.4 BACKFILL MATERIAL

- .1 Type 1: In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of conditions:
 - .1 Verify substrate and project conditions in accordance with Section 01 71 00 - Examination and Preparation.
 - .2 Verify removal of trees, brush vegetation, tree stumps and roots is completed in accordance with Section 31 11 00 - Clearing and Grubbing.

3.2 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Provide erosion and sediment control measures in accordance with Section 01 57 00 - Temporary Controls and temporary controls.
- .3 Trench alignment and depth require department representative's review before placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Dewater excavation, as necessary, to allow placement of culvert bedding in dry condition.
- .2 Place bedding in unfrozen condition.
- .3 Place 200 mm minimum thickness of granular material on bottom of excavation and compact to 95% minimum of maximum dry density.
- .4 Shape bedding to fit lower segment of pipe exterior so that width of at least [50]% of pipe diameter is in close contact with bedding and to provide camber as indicated on the Drawings, free from sags or high points.

3.5 INSTALLATION

- .1 Install pipe, pipe fittings, and appurtenances at locations indicated on the Drawings.
- .2 Lay and join pipe in accordance with manufacturer's recommendations and acceptable to department representative.
- .3 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.
 - .1 Confirm barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Lay corrugated steel pipe:
 - .1 With outside circumferential laps facing upstream and longitudinal laps or seams at side or quarter points.
- .6 Prevent water from flowing through pipes during construction except as permitted by department representative.
- .7 Joints:
 - .1 Corrugated steel culverts:
 - .1 Corrugated steel pipe:
 - .1 Match corrugations or indentations of coupler with pipe sections before tightening.
 - .2 Tap couplers firmly as they are being tightened, to take up slack and provide snug fit.
 - .3 Insert and tighten bolts.

- .4 Repair spots where damage has occurred to spelter coating by applying two coats of zinc rich paint for department representative's review.
- .2 Concrete pipe:
 - .1 Joints may be made with rubber gaskets, bituminous joint compound or Portland cement mortar.
 - .1 Rubber gasket joints:
 - .1 Install in accordance with manufacturer's recommendations.
 - .2 Verify that tapered ends are fully entered into flanged ends.
 - .2 Bituminous filled joint:
 - .1 Make joint, with excess of filler, to form continuous bead around outside of pipe, and finish the inside of pipe smooth.
 - .3 Mortar joints:
 - .1 Clean pipe ends and wet with water before joint is made.
 - .2 Place mortar in lower half of flanged end of pipe section in place.
 - .3 Apply mortar to upper half of tapered end of pipe section being installed.
 - .4 Join pipe ends and force joint up tight, inner surfaces of abutting pipe sections to be flush and even.
 - .5 Clean inside of pipe and annular space between ends of pipes after each joint is made.
 - .6 Fill joint with mortar and finish smooth and even.
 - .7 For pipes 800 mm or less in diameter, fill joints before mortar in joints has set.
 - .8 For pipes over 800 mm diameter, postpone filling joint until backfilling has been completed. Re-clean joints before applying mortar.
- .3 Corrugated polyethylene pipe:
 - .1 Install couplings in accordance with manufacturer's instructions.
- .8 Pipe surround:
 - .1 Place surround material in unfrozen condition.
 - .2 Surround and cover pipes as indicated on the Drawings after completion of pipe laying, and review of the pipe joints by departmental representative.
 - .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated on the Drawings.
 - .4 Place layers uniformly and simultaneously on each side of pipe.
 - .5 Compact each layer to at least 95% maximum dry density.
- .9 Backfilling

- .1 Place backfill material in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Place backfill in unfrozen condition.
- .3 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated on the Drawings.
- .4 Compact each layer to 95% maximum dry density taking special care to obtain required density under haunches.
- .5 Protect installed culvert with minimum 900 mm cover of compacted fill before heavy equipment is permitted to cross.
 - .1 During construction, width of fill, at its top, to be at least twice diameter or span of pipe and with slopes not steeper than 1:2.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Manage waste in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION